MECHANICAL ENGINEERING

JANUARY
•1953•

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Could You Use SAVINGS *Like These?*

40% less
Fuel Consumption
50% more
Boiler Capacity

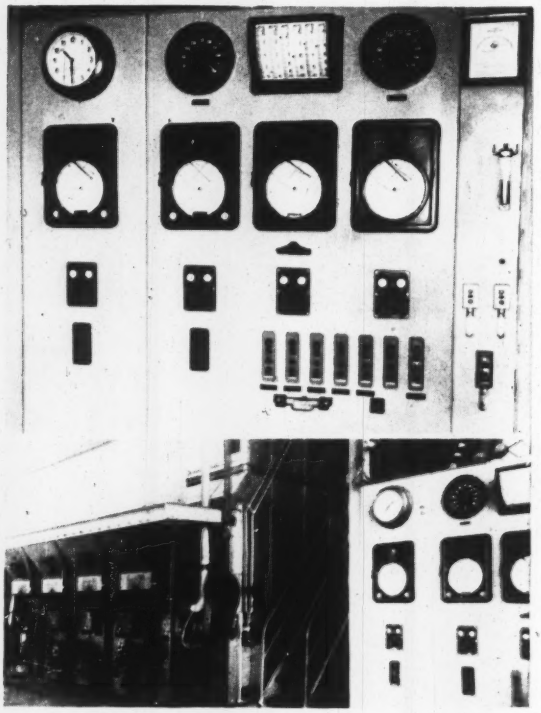
Bailey Meters and Controls Insure Savings at Kerr Bleaching & Finishing Works, Concord, N. C.

The key to complete returns on any investment in new power equipment is a fully co-ordinated system of meters and controls. It's the old story, the tail that wags the dog—careful attention to this comparatively minor part of the over-all installation cost can mean the difference between profit and loss in operation.

Here's where Kerr Bleaching & Finishing Works has cut operating costs—by installing *co-ordinated* Bailey Meters and Controls. The installation includes Bailey Meter Combustion Control, and Bailey Two-element Feed Water Control.

Such a co-ordinated system is an important plus for Bailey customers. Nowhere else can you buy such a complete range of equipment, selected without bias to do the best job for you. Nowhere else can you find such expert engineering service, immediately available through conveniently located direct sales and service representation. May we help you?

Call our local branch office or write for Bulletin 15-H. A-113



Control panel, showing completely co-ordinated Bailey Meters and Controls at Kerr Bleaching and Finishing Works, Concord, N. C.

BAILEY METER COMPANY

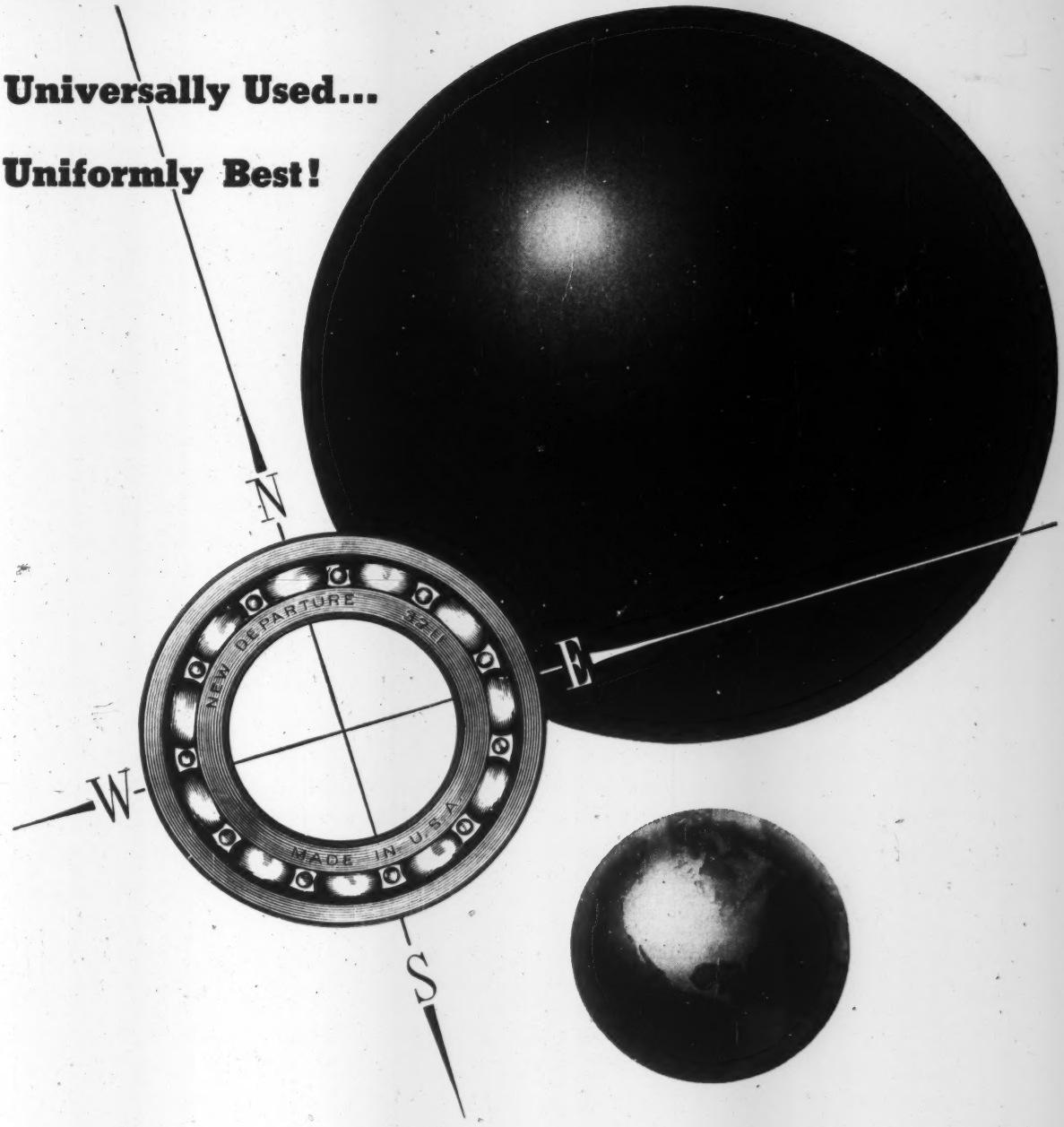
BAILEY METERS

1026 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

Universally Used...

Uniformly Best!



● Throughout the world, New Departure ball bearings are in universal use . . . in motor vehicles and machinery . . . in instruments and implements . . . in conveyor lines and textile looms. Providing support for moving parts, they reduce friction, wear and maintenance . . . permit bigger loads and better design.

● Sixty years of research, engineering and production experience back up the New Departure name. Whether it's a jewel-like instrument bearing, or a giant, New Departure can build it best!

● New Departure's sales engineering staff is always ready to apply its experience to your particular problem.

● New Departure bearings are quickly available at your equipment dealer or bearing distributor—supplied from the industry's largest network of warehouse stocks.

NOTHING ROLLS LIKE A BALL

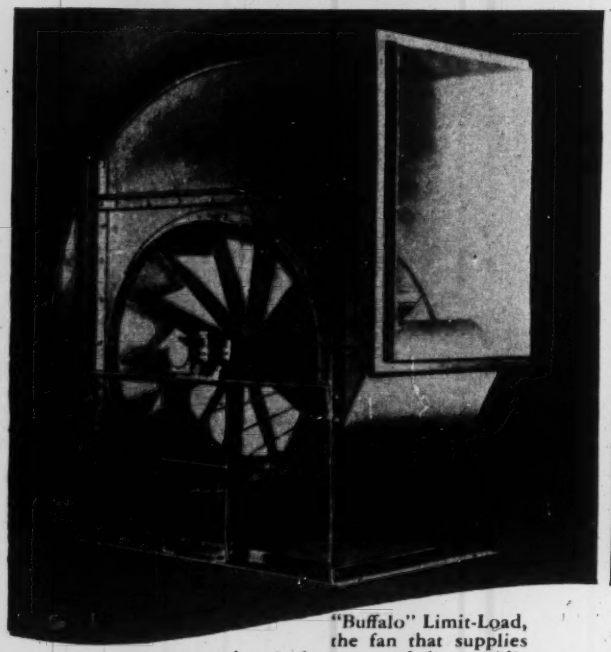
NEW DEPARTURE
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

Also Makers of the Famous New Departure Safety Brake

MECHANICAL ENGINEERING, January, 1953, Vol. 75, No. 1. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations

Let's not overlook QUALITY



"Buffalo" Limit-Load, the fan that supplies the air for many of the world's finest ventilating and air conditioning systems.

The quiet, efficient Type "B" Vaneaxial Fan is one reason why "Buffalo" has earned—and kept—the reputation "First for Fans"

Quality is a relative term—it can be poor, medium, high or the best. We think you should evaluate fans and air cleaning and conditioning equipment according to the "Q" Factor.*

Engineers are not easily mislead when they turn an engineering eye on mechanical things. They know that efficiency is important, and that rugged construction, ease of assembly and repair are also desirable. They value simplicity if it's not for economy of manufacture. Above all, we believe, they admire reliable, long-life performance.

Because in seventy-five years of manufacturing fans, air cleaning and conditioning equipment we have stuck to an original idea—"build it the best we know how", we welcome your critical inspection of Buffalo products. You'll find that both design and construction contribute to their record for long life on the job.

Engineering sales representatives in principal cities are anxious to work with you.

*—*The "Q" Factor—The built-in Quality which provides trouble-free satisfaction and long life.*

75

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

148 MORTIMER ST. BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

VENTILATING | PRESSURE BLOWING AIR CLEANING | COOLING AIR TEMPERING | HEATING INDUCED DRAFT | FORCED DRAFT EXHAUSTING

Easy to Order! . . .

. . . Quick and Easy to Install!

Grinnell Welding Fittings

Any qualified welder can make welds quickly and easily with Grinnell welding fittings. These fittings are made by a hydraulic forging process that assures uniform wall thickness at all points and true circularity throughout. Of seamless, one-piece construction, they can be cut at any angle to match up with standard weight, extra strong and heavier wall pipe in I.D. or O.D. sizes. Pressure-temperature ratings are equal to or greater than those of seamless steel pipe. Grinnell welding fittings are process stress-relieved.

Full data on the complete line of Grinnell seamless carbon steel welding fittings and forged steel flanges is contained in the Grinnell Welding Fittings catalog. Send for a copy.

GRINNELL
WHENEVER PIPING IS INVOLVED

RANGE OF TYPES AND SIZES

Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge Nominal Pipe Size	Light Gauge Iron Pipe Size
ELBOWS 90° Long Radius	½"-30"	½"-30"	1"-12"	¾"-8"	4"-24"	¼"-12"
90° Long Tangent	1½"-12"	1½"-12"				
90° Reducing	2"x¾" to 6"x5"					
90° Short Radius	1"-30"	1½"-30"				
45° Long Radius	½"-30"	¾"-30"	1"-12"	¾"-8"	4"-24"	¼"-12"
RETURNS 180° Long Radius	½"-30"	½"-30"	1"-12"	2"-8"	4"-24"	¼"-12"
180° Short Radius	1"-30"	1½"-30"				
180° Ex. Long Radius	1"-2½"	1"-2½"				
TEES — Straight	½"-24"	½"-24"	½"-12"	½"-8"		
Reducing Outlet	½"-24"	½"-24"	¾"-12"	¾"-8"		
REDUCERS Concentric & Eccentric	¾"-24"	¾"-24"	¾"-12"	¾"-8"		
CAPS	¾"-24"	¾"-24"	1"-12"	1"-8"		
STUB ENDS — Lap Joint	½"-24"	½"-24"				
SADDLES	2"-24"					
LATERALS — Straight	1¼"-24"	1¼"-24"				
Reducing	1¼"-24"	1¼"-24"				
CROSSES — Straight	1¼"-24"	1¼"-24"				
Reducing	1¼"-24"	1¼"-24"				
BACKING RINGS	2"-24"	2"-24"				

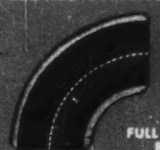
Also available in certain sizes are: 90° long and short radius elbows, 45° long radius elbows and 180° long and short radius returns in Schedules 30, 40, 60 and 80.

Grinnell welding fittings and flanges conform to applicable ASA and ASTM Standards.

GRINNELL WELDING FITTINGS ARE QUALITY-CONTROLLED FOR DEPENDABILITY

TRUE CIRCULAR SECTION

True circular section at all points makes a Grinnell fitting easy to align and weld . . . there is no distortion or no flattening to affect flow adversely.



FULL EFFECTIVE RADIUS

The loss of pressure through Grinnell welding elbows is held down to an absolute minimum . . . because of the full and the effective sweep of the radius.

SMOOTH, CLEAN INSIDE SURFACE

Grinnell Fittings have uniformly smooth inner walls . . . no waves or ridges to cause turbulence or accelerate erosion or corrosion. No pockets to trap solids.

EASY, SWEEPING TURNS

In Grinnell welding tees, corners where outlet joins the run are well-rounded and perfectly smooth to minimize resistance to flow and to prevent trapping.

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
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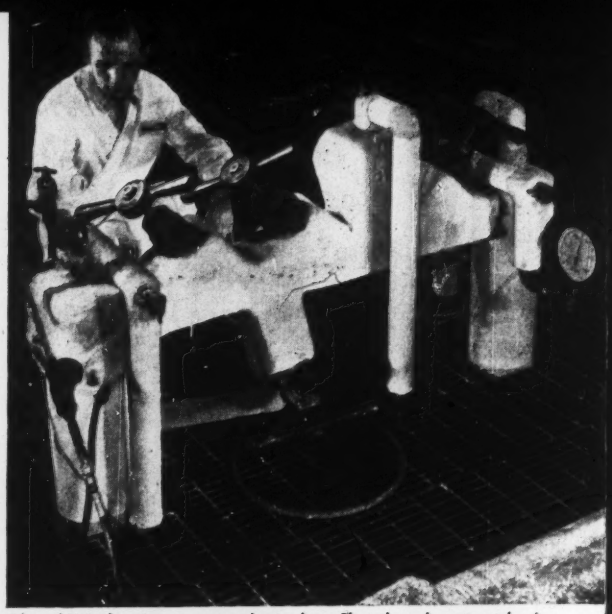
valve values
PHOTO NEWS

Ordeal by SUPERHEATED STEAM *Up to 1300F 5000 psi. for Edward Valves*

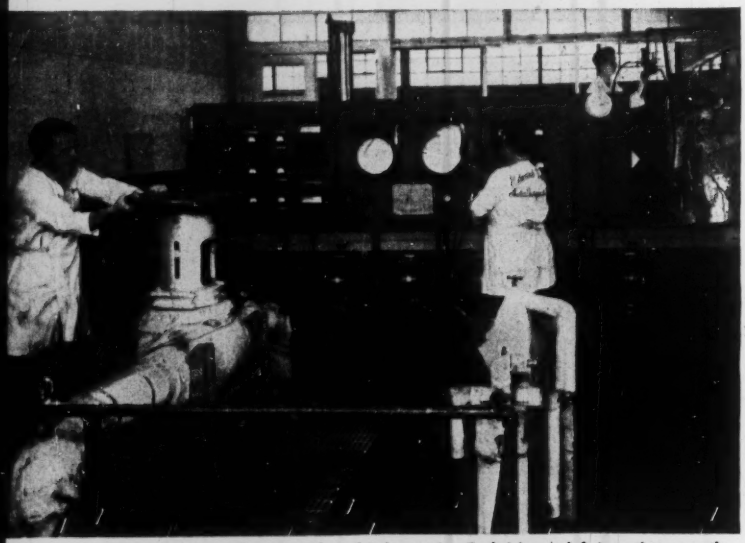
New superheater testing units, developed by Edward engineers and exclusive with Edward, permit a manufacturer for the first time to test valves under conditions much more severe than those they will encounter in today's actual service. These revolutionary new units permit circulating commercial quantities of superheated steam at temperatures up to 1300 F, pressures to 5000 psi. for unlimited periods of time in laboratory tests. Valves are thus subjected to the action of flowing superheated steam with temperatures and pressures far greater than they will meet in actual operation. Possible design weaknesses or operating difficulties are greatly exaggerated and thus readily corrected.

Development of this outstanding new research tool demonstrates Edward's constant search to improve its products—to more than meet the continual challenge posed by constantly increasing temperatures and pressures. For these reasons, Edward maintains the largest laboratories in the world devoted exclusively to research on steel valves. You can continue to expect the best from Edward.



Edward Univalves in test on superheater loop. Flow through center valve is alternated between superheated steam in main loop and high pressure water in and out of tee connection.

Gas operated pit-type furnace used to supplement tests on superheater loops. With this equipment, valve bodies are tested at temperatures up to 1500 F, pressure up to 5000 psi.



Two superheater test loops in Edward Laboratories. Technician at left is testing operation of 6 in., 2500 lb globe valve rated for 1033F, 2500 psi. which is under a thousand hour test at 3500 psi. and 1100 F with flow of 5000 lbs of steam per hour.

Edward Valves, Inc. Another Product

Write for 16 page bulletin giving complete information on tests with revolutionary new superheater loop equipment.

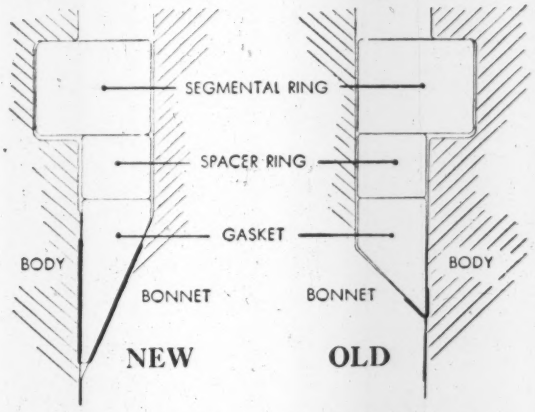
NEW IMPROVED *PRESSURE-SEAL*® DESIGN BY EDWARD

Edward, first to use pressure-sealed construction on non-return valves, has been experimenting for 8 years in an effort to improve on the original PRESSURE-SEAL design.

Final fruit of this research is the new design shown in the diagrams below. Biggest innovation in the new construction is a change in the bonnet-gasket angle from 45 degrees to 25 degrees. Other changes include a recess in the body bore above the gasket area, and a new coating applied to the gasket material.

New design advantages include:

1. THREE TIMES AS MUCH SEALING AREA. The sealing area between body and gasket is now three times greater than with the old construction. This eliminates the possibility of small leaks through minute imperfections sometimes possible with the conventional pressure-sealed construction.



2. TWICE AS MUCH SEALING PRESSURE. The new angular relationship of the bonnet and gasket gives a sealing force twice as great against the gasket for the same line load.
3. SEAL-COATING. A special coating one-thousandth of an inch in thickness is applied to the gasket. When pressure is applied to the gasket, this malleable coating is forced into tool marks and minute imperfections to give a perfect seal.
4. IMPROVED BODY SEALING SURFACE. Special preparation of the vital body-gasket sealing zone insures pressure tightness in this area.
5. EASY DISASSEMBLY. The diameter of the body bore has been enlarged just above the gasket area, facilitating disassembly and eliminating the necessity of pulling the gasket across a corroded area upon disassembly.
6. ELIMINATES GASKET DAMAGE. The cross section of the gasket has been blunted, eliminating a source of damage to the gasket during handling or storage.

Pressure-sealed construction has long been accepted as the most satisfactory for high temperature, high pressure service. These new improvements on the conventional design now available in Edward PRESSURE-SEAL Valves further establish this construction as the obvious choice for more demanding services.

EDWARD VALVES, Inc., *Subsidiary of*
ROCKWELL MANUFACTURING COMPANY
1350 W. 145th STREET • EAST CHICAGO, INDIANA

GLOBE AND ANGLE STOP • FEED-LINE • BLOW-OFF • NON-RETURN CHECK • GATE • GAGE AND INSTRUMENT • RELIEF • STRAINERS

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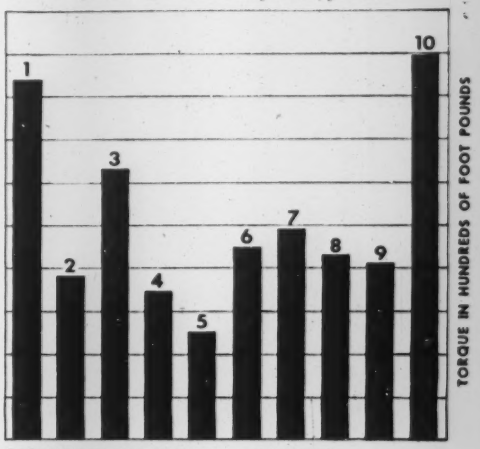
Technical Tips

High Temperature Lubricants For Valve Studs and Bushings

As temperatures increase, the problem of wear and galling between two metal surfaces also increases. Through the years a number of high temperature lubricants have been marketed to solve this problem. Most of these lubricants consist of a solid lubricant in some type of carrier which may or may not be of a lubricating nature itself.

A few years ago another new solid lubricant, molybdenum disulfide, began receiving a great amount of attention. Molybdenum disulfide has a laminar construction in which a plate of sulfur atoms is found on each side of a plate of molybdenum atoms. Molybdenum disulfide will cling tenaciously to a metal surface because of a strong metal to sulfur bond. It will slip easily against other molybdenum disulfide molecules because of the weakness of the sulfur to sulfur bond.

The chart shows the torque necessary to loosen a number of $1\frac{1}{4}$"x7" stud-nut assemblies after 5000 hours at 1000 F in a test conducted in the Edward laboratories. The stud-nut assemblies were lubricated thoroughly with various lubricants before tightening with a torque of 750 ft-lbs.



TORQUE TO LOOSEN STUD-NUT ASSEMBLY

1. No Lubricant
2. Graphite Powder
3. Colloidal Lead
4. Colloidal Copper
5. Molybdenum Disulfide
6. Aluminum Powder
7. Lime-Calcium Base Grease
8. Silicone Grease
9. Colloidal Zinc
10. Colloidal Graphite

These test results show molybdenum disulfide to be a superior stud-nut lubricant. This same superiority is also true for bushing applications. It reduces the coefficient of friction to the lowest values ever obtained on a test in the Edward laboratories and substantially increases operating life.

Edward does not manufacture molybdenum disulfide lubricants. Names of suppliers will, however, be furnished on request.

Edward

NON-STOP FILTRATION FOR ALL YOUR INDUSTRIAL FLUIDS

Continuously cleanable AUTO-KLEAN eliminates need for stand-by strainers

You don't have to shut down your fluid-flow system to clean this strainer. Cuno's exclusive "comb-clean" action provides complete cleaning of the element *—without stopping fluid flow.* Thus, you get non-stop filtration, with no need for a stand-by strainer.

Send your industrial fluids—chemicals, water, fuel and lube oils—through an AUTO-KLEAN. The low-pressure drop of AUTO-KLEAN strainers permits *full-flow* operation on gravity, low pressure, high pressure, or suction lines—with no loss in operating efficiency. AUTO-KLEAN's compact construction allows this continuous full-flow filtration in space which would limit ordinary filters to by-pass service.

Fixed-space metal discs in this modern strainer remove all solids larger than the specified disc spacing—from .0035" to .062".

The low maintenance costs of the AUTO-KLEAN save you money, for there are no cartridges to change. An occasional rotation of the handle does the cleaning job (most units can be equipped with motor-drives for continuous cleaning).

For permanent, positive fluid protection, install compact Cuno AUTO-KLEAN—the precision-built strainer. Send the coupon for free bulletin. A-3.4

Cuno Engineering Corporation
Dept. 654A South Vine Street, Meriden, Conn.

Please send me bulletin on Cuno AUTO-KLEAN

for ....
(fluid)

Name .....

Company .....

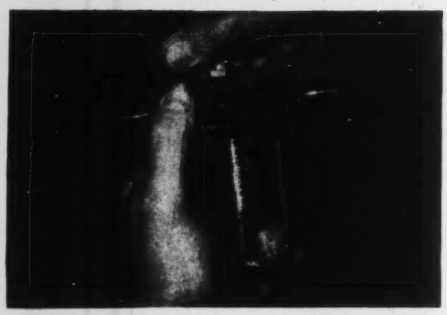
Address .....

City .....Zone....State.....

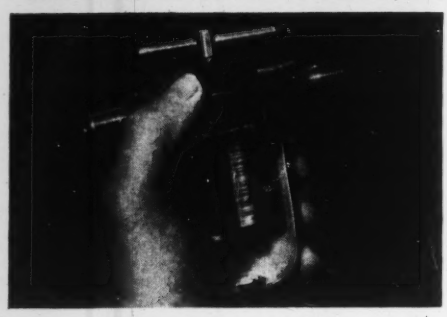
Here's how this strainer "combs" itself clean!

This simple chalk test shows how AUTO-KLEAN's unique built-in comb construction cleans the strainer without costly interruption of flow

ORDINARY BLACKBOARD CHALK leaves heavy deposit of chalk particles on and between discs of Cuno AUTO-KLEAN strainer.



TURNING HANDLE ONE REVOLUTION moves strainer element through comb blades, removing all traces of chalk from between discs. Cuno's exclusive combing operation cleans *thoroughly* —without stopping flow.



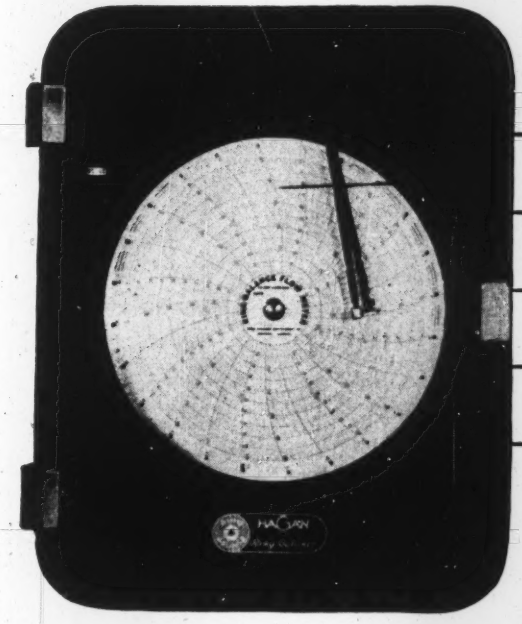
FILTERING AREA IS COMPLETELY CLEAN, restoring full initial capacity. All chalk particles and dirt fall to bottom of housing where they can be drained periodically.

- AUTO-KLEAN's permanent metal filter element is available in steel, brass, or stainless steel for long, trouble-free service.
- AUTO-KLEAN is adaptable to any fluid-flow system.
- From acids to tar . . . if you can pump it, Cuno can filter it. Capacities range from one gallon per hour to 15,000 gallons per minute.

CUNO **ENGINEERED FILTRATION**
Removing More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

Specify HAGAN
RING BALANCE FLOW METERS



This is the versatile Hagan Ring Balance Flow Meter

Models are available which will record, indicate and integrate two flows on a single chart. Standard modifications provide pressure and temperature compensation. Ring assemblies available can measure differentials from 1" to 420" water column maximum at static pressures up to 3,000 psig.

and you get

- **Ease of dead weight calibration**
- **No stuffing boxes**
- **Mercury level not critical**
- **High sensitivity at low flow rates**
- **Adjustable full scale range**

HAGAN RING BALANCE METERS provide dependable, accurate flow measurement of oxygen, water, steam, gas, oil or other fluids. Design is simple, maintenance costs low.

• • •

For more information about Hagan Ring Balance Flow Meters, and how they can help you solve your metering problems, fill out the coupon.

Clip this coupon for information

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HAGAN BUILDING, PITTSBURGH 30, PA.

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND AERONAUTICAL TESTING LABORATORIES

HAGAN HALL BUROMIN CALGON

Hagan Corporation
Hagan Building
Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters. I am particularly interested in .....

.....

NAME .....

POSITION .....

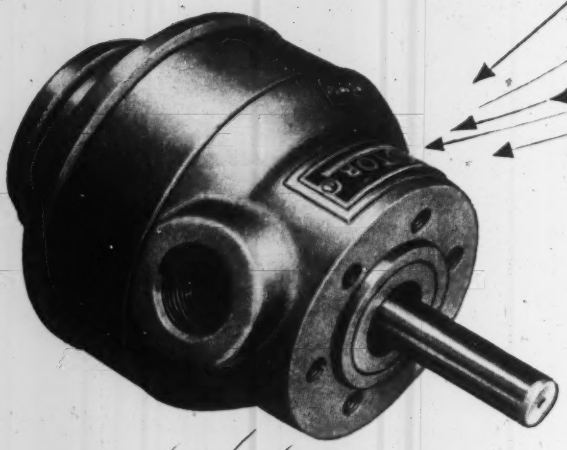
COMPANY .....

STREET AND NUMBER .....

CITY ..... ZONE ..... STATE .....

MECH-1

the "label" tells you it's unique



See the Gerotor name-plate on a hydraulic pump and you know what's inside . . . the renowned Gerotor mechanism. Both elements revolve in the same direction at low relative speed . . . minimizing friction, wear and slippage . . . assuring longer life, smoother flow, higher efficiency at lower operating cost.

Gerotor pumps are available in eleven sizes, some engineered for pressures up to 1200 p.s.i. continuous, 1500 p.s.i. intermittent. Deliveries range from .4 g.p.m. at 1800 r.p.m. to 40 at 1200. Plain, base or flange mountings. Specify Gerotor!

Gerotor May Corporation, Box 86, Baltimore 3, Md.

no other hydraulic pumps are like

GEROTOR
HYDRAULIC PUMPS

American Blower Sirocco Fans

American Blower Series 81 Sirocco Fan. All Sirocco Fan ratings are certified in accordance with the Standard Test Code.

The Heart of Air Conditioning

So quiet it's hardly noticed, so compact it conserves valuable space, so efficient it's actually the heart of this hospital's vital air conditioning system.

American Blower Sirocco Fans occupy less space and deliver more air per revolution than any other type fan. Slower speed means quieter operation, decreased wear, minimum maintenance.

Many thousands of Sirocco Fans have been installed throughout the world since 1908. Over the years many refinements have been included. New methods of construction have been perfected. But these fans still retain the proved Sirocco principle of delivering more air per revolution.

For data on how the Sirocco Fan can be used in your business, call the nearest American Blower Branch Office.

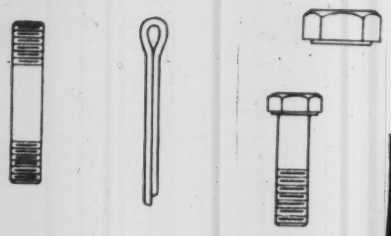
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

YOUR BEST BUY IN AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS HEATER



A HARPER SPECIAL...

to solve your special problem...

On the equipment you manufacture, a special fastening by Harper may improve your product—cut costs—speed assembly—or simplify maintenance.

Harper regularly produces hundreds of special type fastenings for a wide range of products. Qualified engineers and metallurgists, backed by over a quarter century of experience, are available to work with you on the design and production of fastenings engineered to your specific requirements.

The H. M. Harper Company is also the world's largest exclusive producer of standard fastenings made of non-corrosive metals and all stainless steels. Over 7,000 items are regularly carried in stock. Call the Harper Branch Office or Distributor nearest you. And remember, Harper engineers and metallurgists are eager to help you solve any tough corrosion problem.

Tap Changer Fastening of Copper Used in Transformers

THE H. M. HARPER COMPANY
8243 Lehigh Avenue, Morton Grove, Illinois

BRASS · SILICON BRONZE · NAVAL BRONZE · ALUMINUM

MONEL · ALL STAINLESS STEELS

SPECIALISTS IN ALL NON-CORROSIVE METALS

HARPER

EVERLASTING FASTENINGS

Before you buy an Expansion Joint

Read this!

Anyone in industry today recognizes those compelling factors which cause "purchase by price".

What is not so easy to see is that the "lowest price" is certainly no indication of the *value* of a product—no matter what it is!

That is why Zallea Expansion Joints—even though maintaining a competitive price position in their field—*guarantee performance* and *quality*. These characteristics are built into every Zallea Expansion Joint which has ever left our plant—and are measurable in dollars and cents by any industrial buyer.

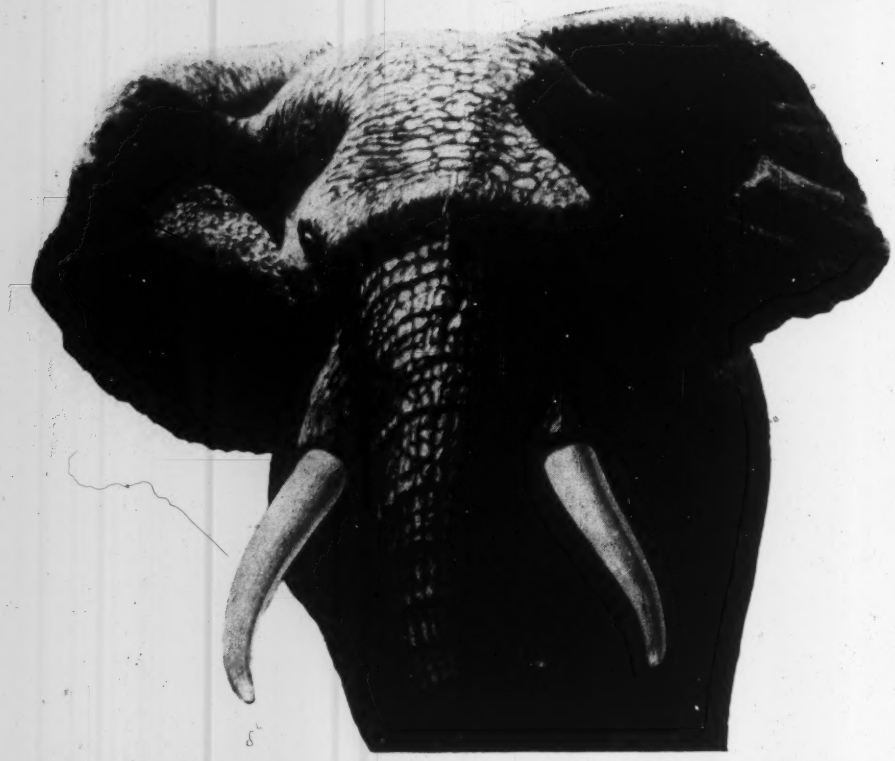
You will find—as have thousands of others—that the value of a Zallea Expansion Joint is in direct proportion to its service life. The proof? *Repeat orders* from customers *by the hundreds* in the last quarter of a century.

Before *you* buy an expansion joint, check *first* with a Zallea Representative for *proof* that your best buy is Zallea. There's no obligation, of course. Zallea Brothers, 820 Locust Street, Wilmington 99, Delaware.

Catalog 47 and Bulletin 351 describe the complete line of Zallea Expansion Joints and Flexible Connectors.™ Write for copies today.

Zallea
EXPANSION JOINTS

You can't stop an elephant with a sling shot



You can't stop corrosion with ordinary paints . . . it takes BITUMASTIC COATINGS!

CORROSION can't be stopped by ordinary paints or conventional protective coatings. They can't protect surfaces against the ravages of rust for any appreciable length of time. But Bitumastic Coatings can!

FIRST—Unlike maintenance paints, Bitumastic® Protective Coatings are specially formulated from a coal-tar pitch base* that is, for all practical purposes, impervious to water. When you keep moisture away from an exposed surface, you *stop* corrosion.

FURTHER—Bitumastic Coatings provide an extra-tough, extra-thick barrier against corrosive elements—a barrier that is impenetrable. These coatings provide up to 8 times the film thickness of conventional paint coatings.

FINALLY—Bitumastic Coatings stop corrosion caused by moisture—acid fumes—alkaline fumes—corrosive soil—salt air—heat. There are 6 Koppers Coatings—formulated to control corrosion of metal and deterioration of concrete. Use coupon for full information.

**Hi-Heat Gray contains a metallic base.*

SEND FOR SET OF FREE BOOKLETS!

Koppers Company, Inc., Tar Products Division
Dept. 169-T, Pittsburgh 19, Pa.

Please send me, without charge or obligation, complete information on corrosion prevention.

Name .....

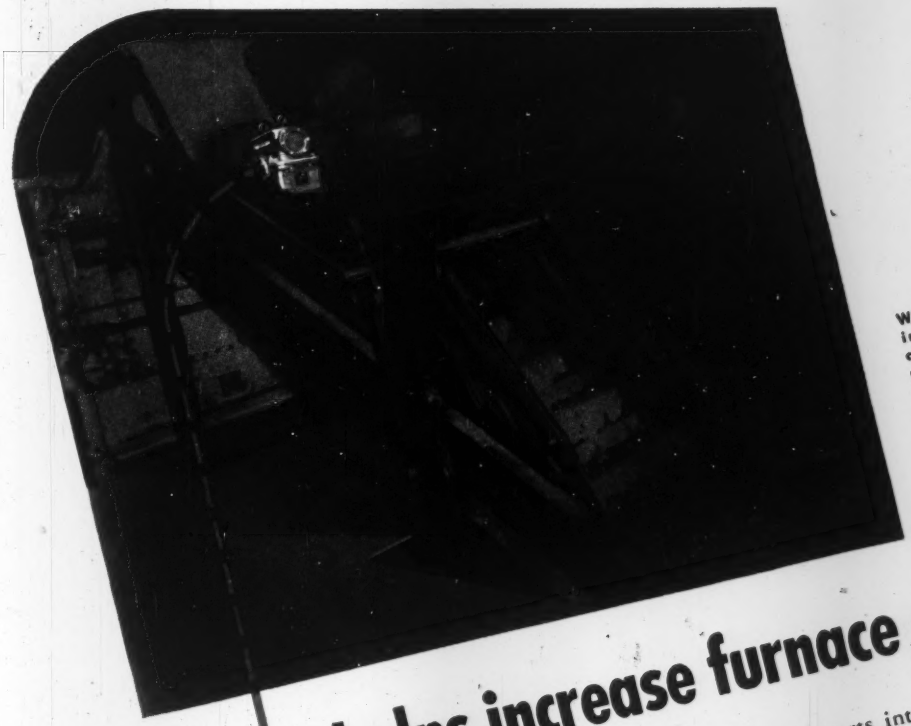
Address .....

City ..... Zone ..... State .....

KOPPERS **BITUMASTIC PROTECTIVE COATINGS** SOLD THROUGH INDUSTRIAL DISTRIBUTORS

KOPPERS COMPANY, INC., Tar Products Division, Dept. 169-T, Pittsburgh 19, Pa.

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.



WORM GEARING — universal in its application — affords advantages for almost every power transmission job. Select worm-gear units to meet your need from the complete Cleveland line. Write now for new 180-page Catalog 400, just off press.

Photo of Michigan Crane & Conveyor parts-loader in the Commonwealth Industries, Inc., plant at Detroit, by courtesy of The Iron Age.

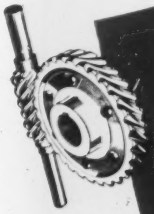
CLEVELAND helps increase furnace output 10%

DRIVING a conveyor that loads small parts into a continuous heat treat furnace 24 hours a day is punishing service. That's why Commonwealth Industries turned to a long-lasting, trouble-free Cleveland. Set up to maintain a steady, sure furnace-feeding pace, Cleveland helped increase furnace output 10% in one year's time. In addition, labor-savings of $17,500 were realized over the same year's period.

Wherever Clevelands serve—and you'll find them in most industries—engineers will tell you that Clevelands do their work under heavy loads, continuously or intermittently, no matter how severe the conditions, with a minimum of attention.

In or near your city, there's a Cleveland engineer ready to serve you. He will be glad to discuss your power transmission problems and suggest proper drives to meet your particular needs. The Cleveland Worm and Gear Company, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

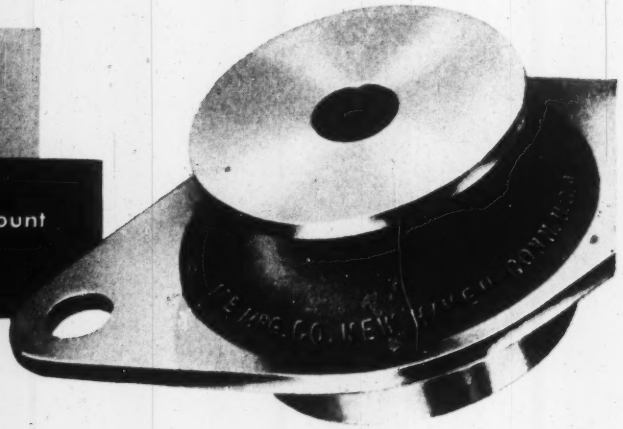


CLEVELAND
Worm Gear
Speed Reducers

Vibration Engineering that solves your problems

PROBLEM: To provide superior vibration control while simplifying suspension design

SOLUTION: The Isomode* Type 5 Mount that isolates all modes of motion



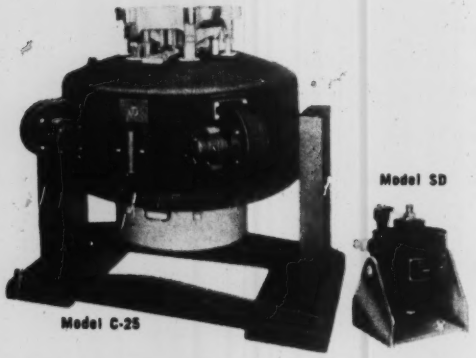
HOW to get optimum isolation into a product design? The answer is not always easy. But it was made much easier to find when Isomode Mounts were developed. They offer what's needed for outstanding results—namely, control of horizontal and rocking motions as well as vertical vibrations.

And here's why. Isomode Mounts have equal spring rates in all directions. They therefore absorb vibrations from all directions equally well. As a result, they can be mounted at any angle, permitting location of ideal suspension points and simplifying design.

In addition, Isomode Mounts have high load capacity in compact size, saving both space and weight. Large rubber volume for their size lends softness for good isolation, yet the mounts are stable, self snubbing and long lasting.

These mounts are an example of the kind of vibration engineering put to work for you at MB. Many companies have found it good practice to make MB their headquarters for vibration information. You will too—on vibration *isolation, control, testing, detection* or *measurement*. For more details on Isomode Mounts, be sure to write for Bulletin 410-4.

*Trade Mark Reg. U.S. Pat. Off.

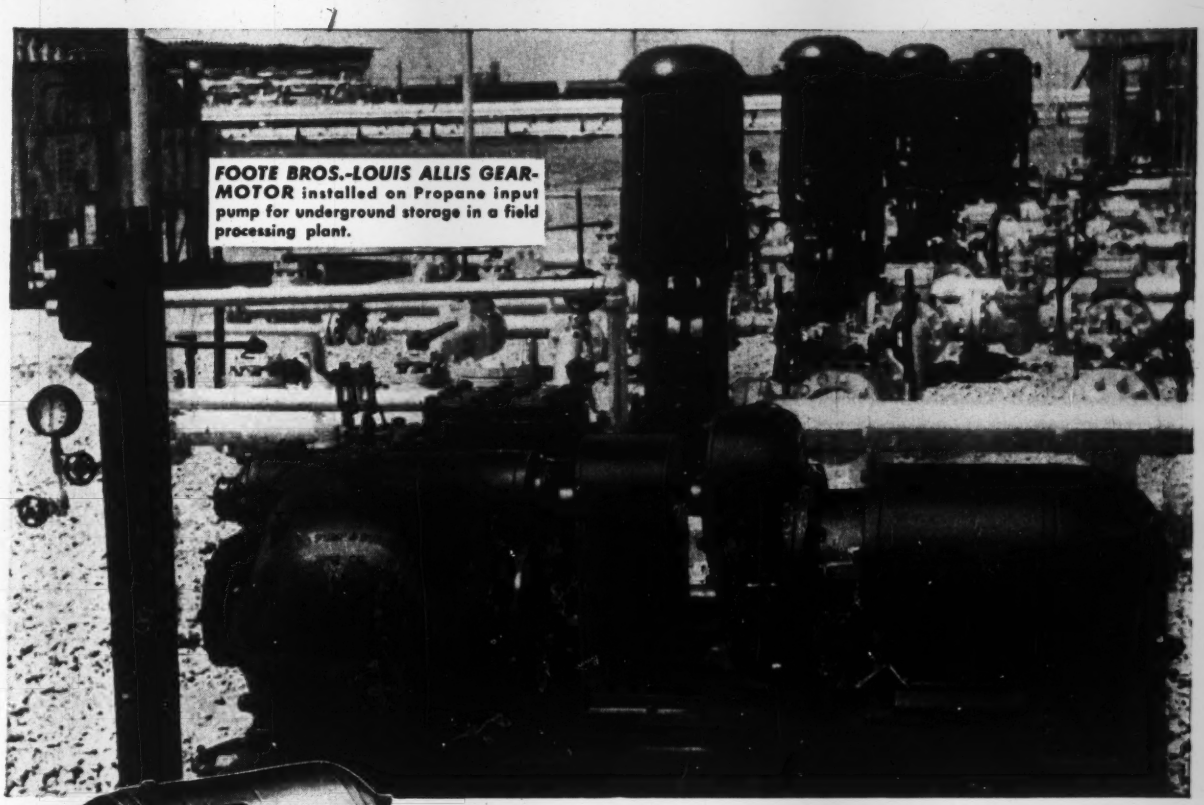


A vibration exciter to meet your needs

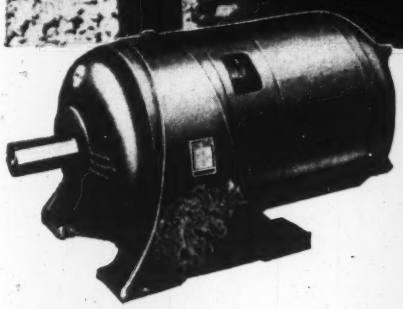
Whether your shake testing requirements are of large order or small, there's an MB Shaker for the job. Model SD, for example, has rated force output of 10 pounds; while the C-25 provides 2500 pounds. Model also available for 10,000 pounds. So if you have to vibration test to MIL-E-5272, be sure to check up with MB. Bulletin No. 1-VE-4 gives technical data on MB Shakers. Write for it.

THE MB MANUFACTURING COMPANY, INC.
1060 STATE STREET, NEW HAVEN 11, CONN.

PRODUCTS AND EQUIPMENT TO CONTROL VIBRATION • TO MEASURE IT • TO REPRODUCE IT



FOOTE BROS.-LOUIS ALLIS GEAR-MOTOR installed on Propane input pump for underground storage in a field processing plant.



When the Going's Tough

IT'S FOOTE BROS-LOUIS ALLIS GEARMOTORS FOR SERVICE,

Out in the oil fields, there's no time to "baby" equipment. Quality counts and quality must be coupled with the rugged, sturdy ability to stand up under day-in and day-out service.

It is on jobs like these that the inherent stamina — the high quality — of Foote Bros.-Louis Allis Gearmotors prove themselves.

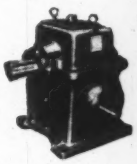
Compact in design, quality built throughout, these gearmotors incorporate Duti-Rated Gears with file-hard surfaces and resilient cores. The cast iron housings give rigidity, and the large oil reservoir with splash lubrication means continuous trouble-free operation.

Foote Bros.-Louis Allis Gearmotors are available in single, double, and triple reductions, to provide output speeds of 780 down to 7.5 r.p.m. and capacities from 1 h.p. through 150 h.p. Open drip-proof, splash-proof, enclosed and explosion-proof motor enclosures are available.

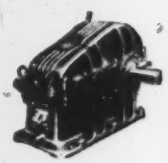
FOOTE BROS.

Better Power Transmission Through Better Gears.

LINE-O-POWER DRIVES



HYGRADE DRIVES



MAXI-POWER DRIVES

Foote Bros. Gear and Machine Corporation
Dept. Q, 4545 S. Western Boulevard
Chicago 9, Illinois

Please send me Bulletin GMA containing full information on Foote Bros.-Louis Allis Gearmotors.

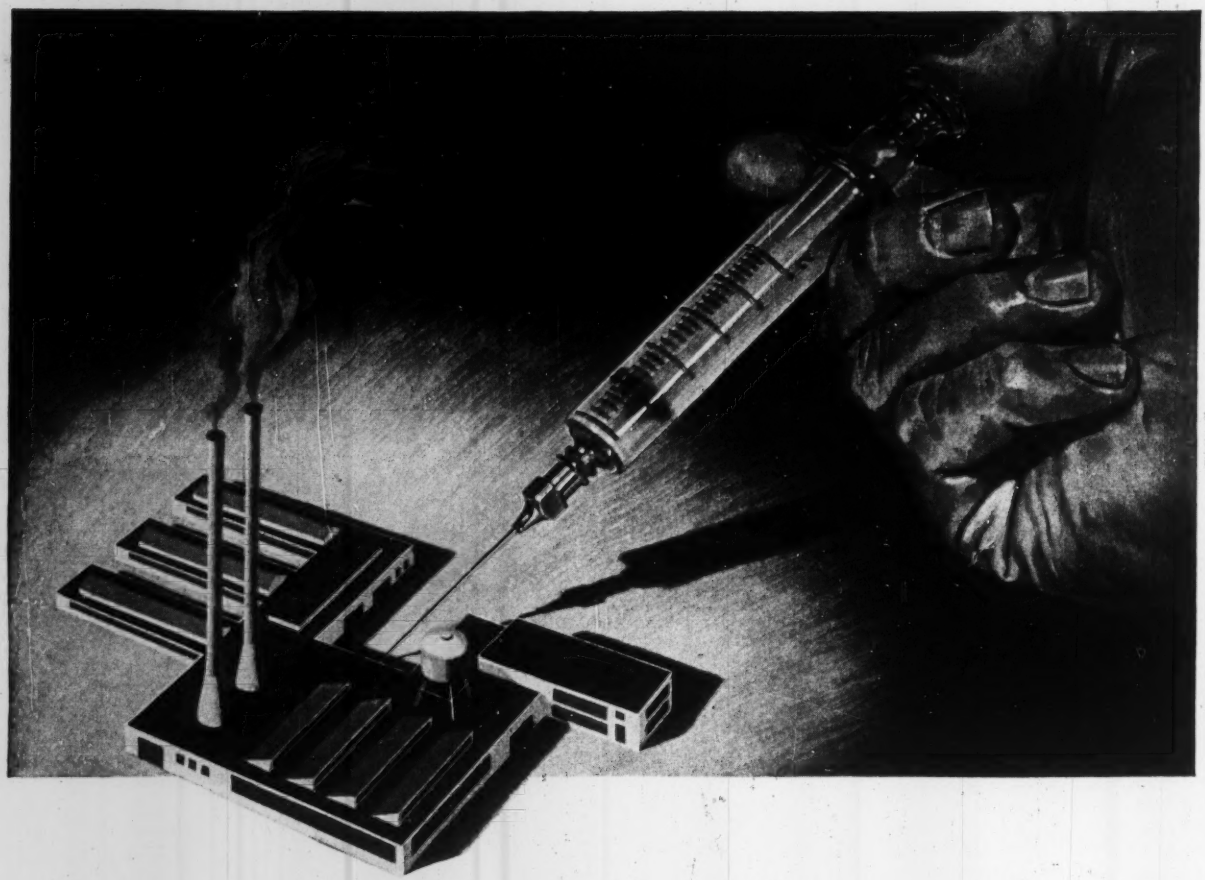
Name.....

Company.....

Address.....

Position.....

City..... Zone..... State



Vitamins That Make Production Grow

Perhaps, like many producers these days, you've found today's heavier demands are asking more from your equipment than it can produce.

Consider how one typical company injected new productivity into *its* operation:

This was a soap processor who needed extra production and new fuel economy for a process involving crude with a high salt content. Development of a specially-built still pot of economical clad steel eliminated need of multiple distillation . . . reduced fuel and maintenance . . . speeded up heating . . . ended corrosion . . . provided structural strength to withstand vacuum—*and cut first equipment cost, too.*

What makes this story significant is that it resulted from a progressive planning method followed by certain Equipment Builders.

These specialists bring leading engineers, designers, and materials suppliers into the planning of your equipment. Each factor affecting performance *is thought out by a specialist in that field.* And in such planning, you'll find these builders turning to Lukens for its knowledge of materials, as well as its wide range of low-cost clad steels.

Even with new equipment often difficult to get these days, we know builders who can recondition what you have for better performance, better profits. Write us today, explaining your need. Manager, Marketing Service, 402 Lukens Building, Coatesville, Pennsylvania.

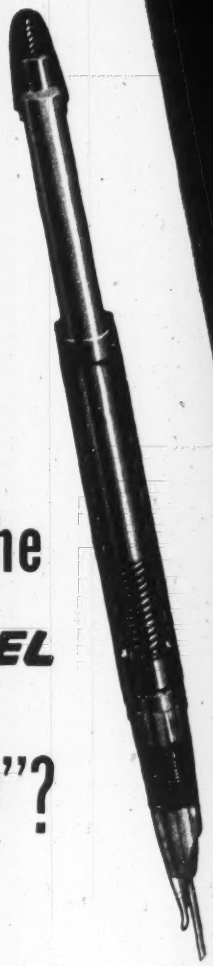
LUKENS

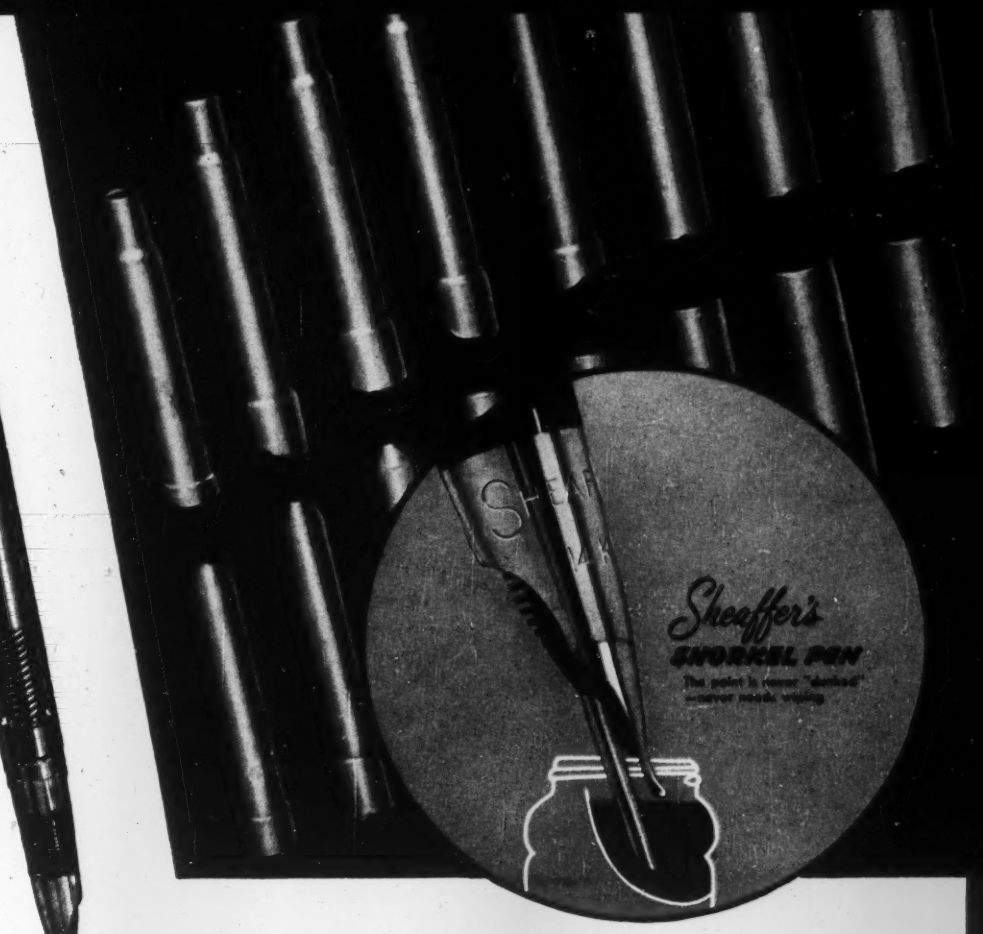
World's Leading Producer of

SPECIALTY STEEL PLATE · PLATE SHAPES · HEADS · CLAD STEELS

LUKENS STEEL COMPANY, COATESVILLE, PA.

What makes the SNORKEL PEN "breathe"?





Sheaffer's new Snorkel Pen created a sensation when it was introduced to the trade. Using air alone, the pen is emptied, cleaned and refilled through the filling tube of the Snorkel Pen with a one-stroke touch-down action.

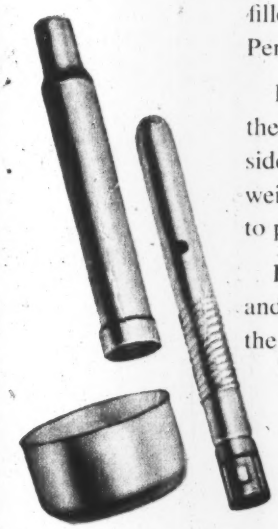
Designing the two brass "lungs" comprising the plunger-siphon mechanism called for considerable ingenuity. They must be light in weight, stiff and strong, easy to form and easy to polish and plate.

Formbrite* met all of these requirements—and more. With a metal thickness of only .0058", the 2" long cylinders are formed in multi-plunger presses in eight successive operations—*without annealing of any kind.*

Formbrite's superfine grain resulted in a harder, stronger, longer-lasting product with savings up to 50% in polishing costs.

Surprisingly, Formbrite, with all the plus values it offers over conventional drawing brasses, costs no more. See the reverse page for another application of Formbrite. And write for Publication B-39, addressing The American Brass Company, General Offices, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Limited, New Toronto, Ontario, Canada.

*Reg. U.S. Pat. Off. 5295



Cups like this, blanked and formed in one operation from Formbrite strip $1\frac{11}{16}$" x .0058", are magazine-fed into multi-plunger presses. Eight successive operations produce the sleeves illustrated at top of page *without annealing*. Sleeves at left are finished, ready for chromium plating.

Formbrite
is an
ANACONDA PRODUCT
Made by The American Brass Company

You can do this *better cheaper faster* IF THE METAL IS Formbrite

Since The American Brass Company introduced Formbrite* as a superior drawing brass, scores of stamping shops, polishing and plating rooms throughout the country have changed their thinking.

Comparative tests prove conclusively that the superfine grain structure of this specially processed forming brass means stamped and formed products that are stronger, harder, "springier" and more scratch-resistant. Yet the metal is so ductile that it can be readily formed, drawn and embossed.

Timestudies made of finishing operations have shown that a bright, lustrous finish can be obtained by a simple "color buffing" operation in half the time previously required.

That's why we say you can do it *better, cheaper and faster* with Formbrite. Millions of pounds of Formbrite sheet and strip have been produced and economically fabricated into hundreds of different products. Want a sample—and more information? Address The American Brass Company, General Offices, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Limited, New Toronto, Ontario, Canada.

5695

*Reg. U.S. Pat. Off.

In the pressroom of a supplier, the back of a military brush is blanked from Formbrite red brass strip.

Empire Brushes, Inc., Port Chester, N. Y. produces an extensive line of military and clothing brushes with Formbrite components. At right, a decorative band is being applied.

Formbrite
is an
ANACONDA PRODUCT
Made by The American Brass Company

for the vital job of cooling lube oil on these pumps and blowers

Roots-Connersville selected Ross Exchangers

The ability of Roots-Connersville blowers, exhausters and pumps to maintain peak performance even under the most challenging conditions, stems from 98 years of experience in sound engineering and fine craftsmanship.

This record naturally precludes any gamble with the quality of outside-built components. Logically then, the exchanger selected to fully safeguard lube oil temperature must be of known quality and proven efficiency.

Thus, to protect its reputation and match its claims of long-time durability and freedom from breakdown, Roots-Connersville has become a large user of Ross Type BCF Exchangers in both its centrifugal and rotary positive type machines, especially on larger units like those shown.

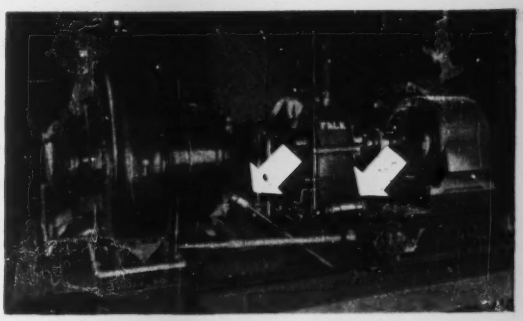
Ross Type BCF Exchangers are contributing to the peak performance of hundreds of thousands of machines produced by other leading manufacturers. Pre-engineering, full standardization and mass production have made these compact, all-copper and copper alloy units vastly preferred throughout industry.

Insist on Ross Exchangers for the machines you build, buy or now operate. Write for Bulletin 1.1K5.

KEWANEE-ROSS CORPORATION
DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
1411 WEST AVENUE BUFFALO 13, N. Y.

ROSS
EXCHANGERS

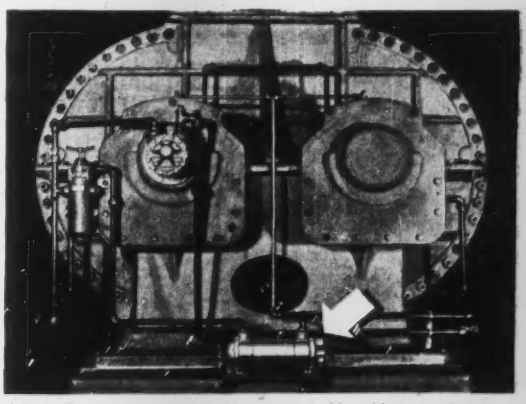
KEWANEE-ROSS PRODUCTS



Roots-Connersville high pressure rotary gas booster motor driven through a speed reducer, both equipped with Ross Type BCF Exchangers.

Battery of Roots-Connersville turbine driven multi-stage centrifugal blowers handling coke oven gas, all equipped with Ross Type BCF Exchangers.

Four Roots-Connersville multi-stage centrifugal air blowers, each equipped with a Ross Type BCF Exchanger.



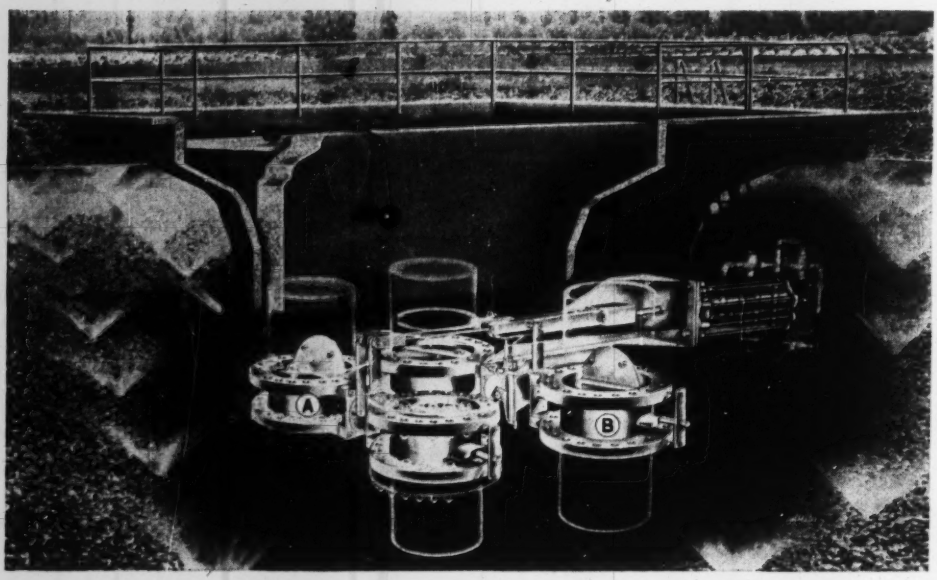
Roots-Connersville rotary positive steam turbine driven gas booster equipped with Ross Type BCF Exchanger.

Serving home and industry

AMERICAN STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



R-S Simplified Sewage Control System

This dosing pit control system is located in the Ontario-Upland, California, sewage treatment plant. In continuous operation day and night for over two and one-half years, it shows the tandem cycling of the valves which occurs every four minutes.

The system consists of four twenty-four inch heavy duty R-S Valves operated by a single water cylinder through cross linkage. While the far pit is filling through valve (A), the near pit is draining through valve (B) and discharging through the spray nozzles. As soon as the far pit is full, the float control will actuate the water cylinder by means of air operated three way valves, thus draining the pit and filling the near pit at the same time. Handwheel operation is provided for emergency use.

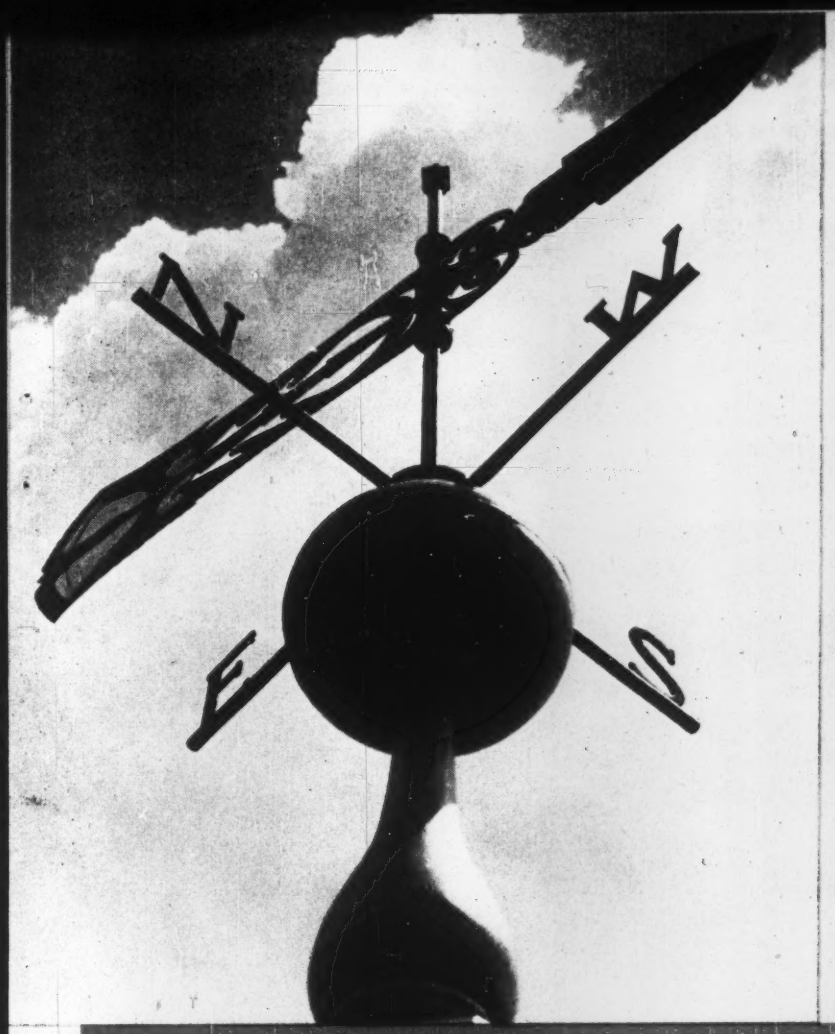
Rugged construction with minimum friction means long life and trouble-free operation for R-S Valves.

Consult your local R-S Valve Engineers, or write direct.

R-S PRODUCTS CORPORATION • 4600 Germantown Ave., Philadelphia 44, Pa.

An S. Morgan Smith Company Subsidiary

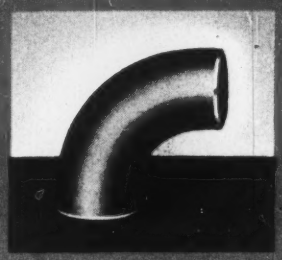
DISTRICT OFFICES IN PRINCIPAL CITIES



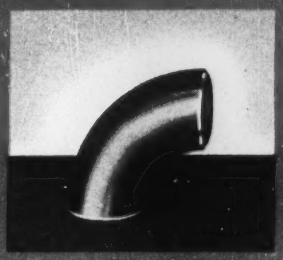
A Four-Way Selection

This photograph of a weather vane seems a good way to point out the fact that there are four different types of Midwest Welding Elbows (see below). These are more types than are manufactured by any other company. This greater selection is important to users of welded piping because it gives the engineer greater latitude in piping design and permits improvements and economies not otherwise possible in welded piping systems. For more information on this subject, ask for Catalog 48.

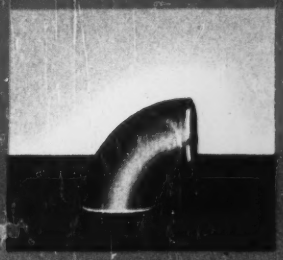
MIDWEST PIPING & SUPPLY CO., INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices:
New York 7—30 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.
STOCKING DISTRIBUTORS IN PRINCIPAL CITIES



MIDWEST "LONG TANGENT"
Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than A.S.A. Sizes to 24".



ASA STANDARD
Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings. ASA B16.9. Tolerances much less than allowable. Sizes to 28".



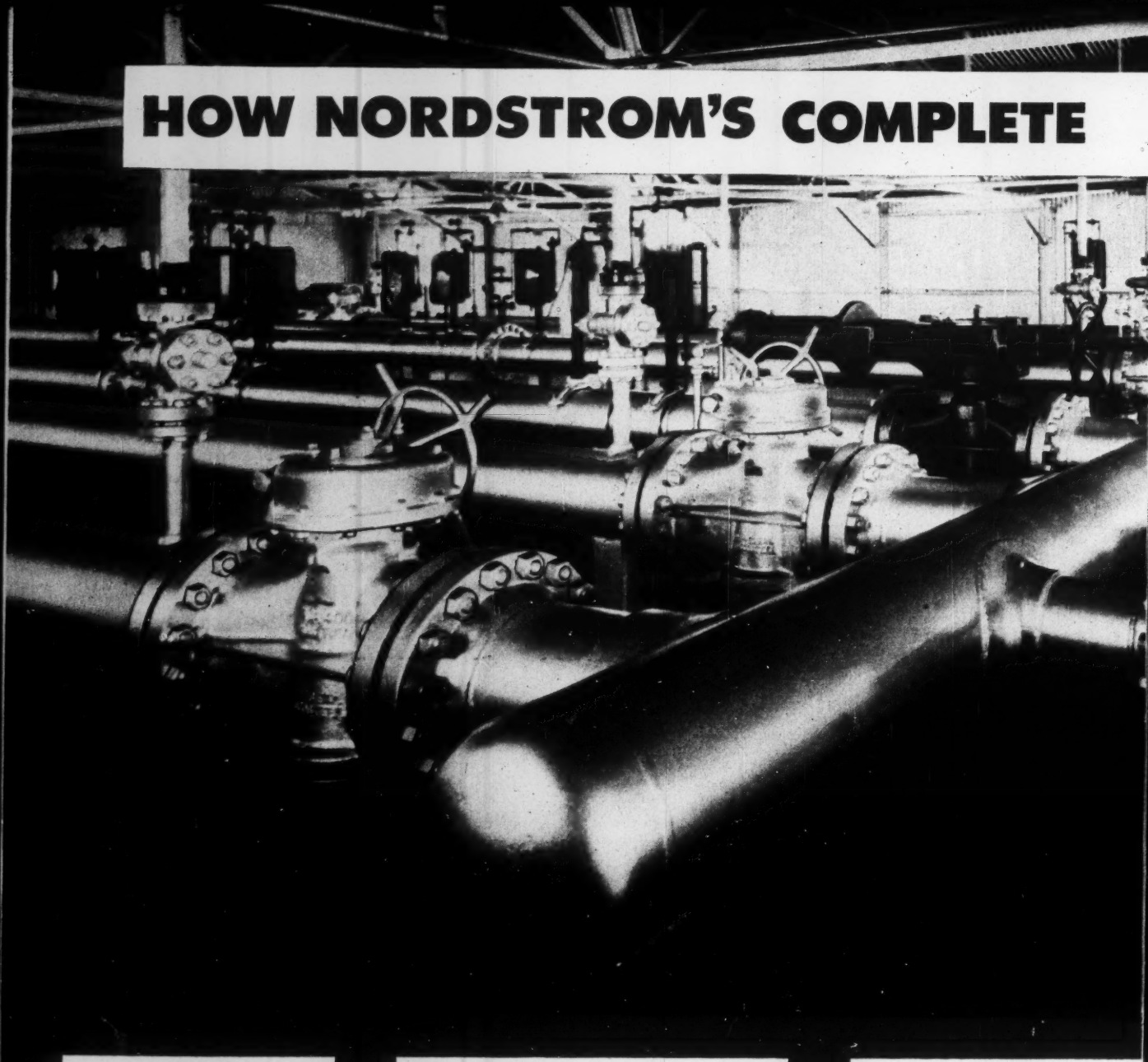
SHORT RADIUS
Recommended where space is limited. Sizes to 30". Also available with "Long Tangents" in sizes 14" to 30".

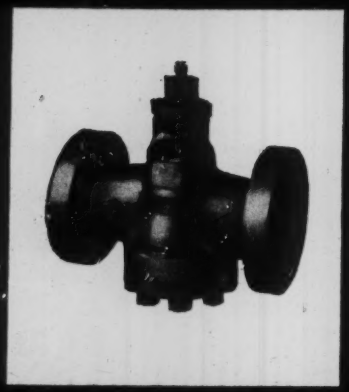
MIDWEST REDUCING
Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

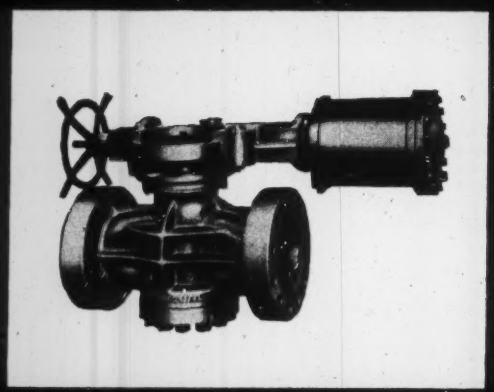
MIDWEST WELDING FITTINGS

IMPROVE PIPING DESIGN AND REDUCE COSTS

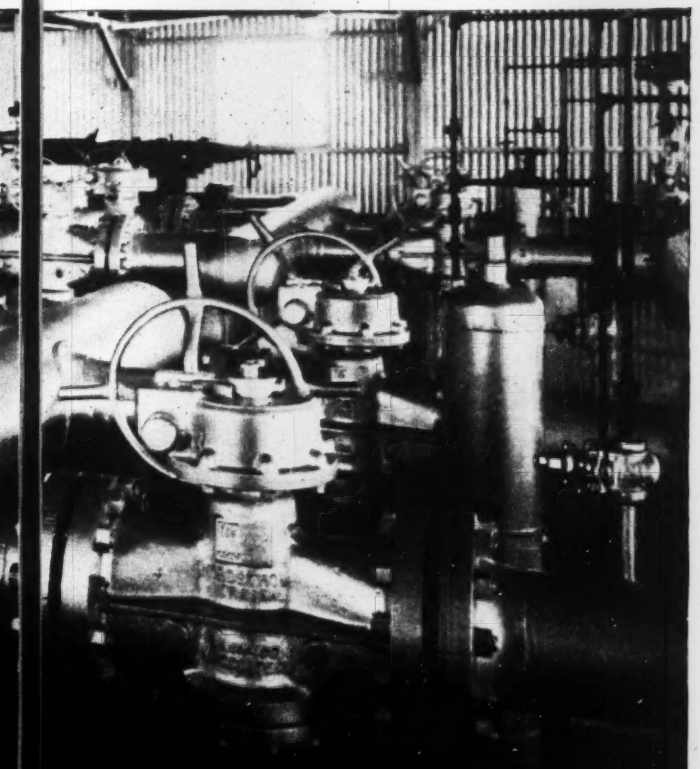
HOW NORDSTROM'S COMPLETE

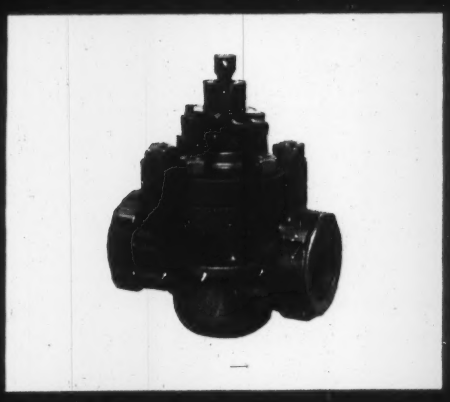






LINE LETS YOU STANDARDIZE ON





Lubricated VALVES

Because of widely varying pressures, temperatures or service conditions it is often necessary to use a number of different types of valves in a single installation, just as in the case of the gas regulating set-up here.

With Nordstroms it is possible to get the benefits of lubricated valves and yet standardize on a single source of valve responsibility for the entire hook-up. Only Nordstrom lubricant-sealed valves are available in a *complete* range of metals, types, patterns and pressure ratings with flanged, screwed and butt-welding ends, equipped for wrench, gear or automatic operation.

Only Nordstrom, too, gives you Hypermatic lubricant—automatic lubrication; easy maintenance.

Through this wide diversification, Nordstrom can furnish you with valves practically "tailor-made" for your service. This means that Nordstroms, perfectly fitted to the conditions in your lines, will operate more efficiently and last longer.

All Nordstroms, of course, embody such standard features as lubricant-sealed shut off, quick quarter-turn to open or close, unexposed seating surfaces, and streamlined flow without sediment-catching crevices.

For information on which type of valve is best suited to your services, contact your Nordstrom representative or write Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL Built
Nordstrom Valves
Lubricant-Sealed for Positive Shut-Off

Another Rockwell Product

The result's the same... the cost is not

Despite the superior performance of silicone rubber when exposed to extremes of temperature, high cost has retarded its extensive use. To ease the cost problem, The Sponge Rubber Products Company makes a *cellular* silicone rubber. For many, Spongex silicone rubber can offer substantial savings.

Cellular structure reduces the need for large quantities of expensive silicone and rubber, yet maintains the properties important to users of silicone rubber.

Check your use of silicone rubber—maybe we can help you cut costs. Write us at the address below for further information.

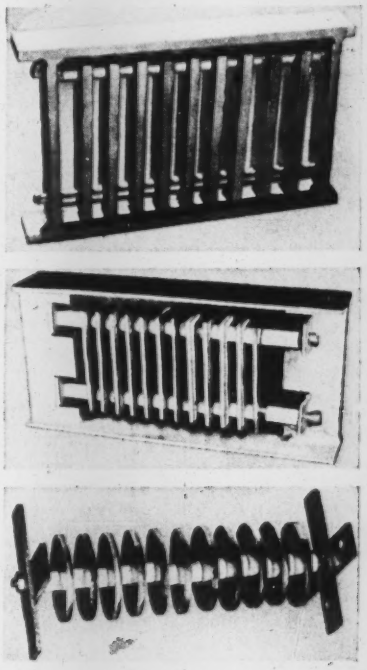
Spongex *cellular* silicone rubber is available in cord, tubing, strips, slabs, die cut shapes and molded forms.

SPONGEX® Cellular Silicone Rubber

used under extremes of temperature conditions for cushioning, insulating, shock absorption, sound and vibration damping, gasketing, sealing, weatherstripping and dust proofing.

THE SPONGE RUBBER PRODUCTS COMPANY 601 Derby Place, Shelton, Conn.

How INCO HIGH-TEMPERATURE ENGINEERS SEEK THE ANSWER TO A PROBLEM



High-Temperature Test Racks are supplied in different styles or shapes when necessary for placing in the corrosive atmosphere. All are basically a selection of *different* metals — which are exposed simultaneously to the corrosive conditions.

Inco High-Temperature Service is ready to assist you on metal problems at high heat with all its knowledge of high-temperature metal performance.

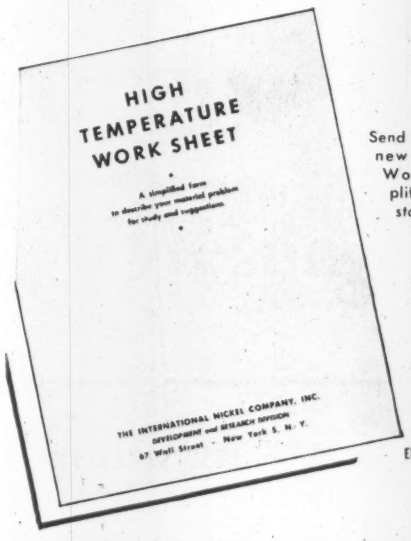
In laboratories at Bayonne, N. J., and Huntington, W. Va., creep tests measure the load-carrying ability of various alloys at temperatures up to 2100°F.

Other tests are constantly adding to the knowledge of how metals behave under varying degrees of heat and corrosive conditions. These laboratory studies are extended by field work. Investigation of metals serving in high-temperature applications reveals why some metals stand up where others fail. Corrosion is often the most important cause of damage and failures.

In field work Inco Engineers make use of High Temperature Corrosion Test Racks, shown above, to observe the effects of corrosive atmospheres. These carry a selection of different alloys which are placed right in the existing equipment to give a direct comparison of the various materials under actual service conditions.

After removal, the samples of various alloys are examined. The suitability of the alloys or the degree of damage is evaluated from the appearance of scale, the depth of attack, and other data derived from metallographic study and mechanical testing.

In your high-temperature problems, whether in present activities or in new projects, Inco High-Temperature Engineers will be glad to work with you. Let them send you the High-Temperature Work Sheet . . . to aid you in explaining your problem. Then see if Inco Engineers cannot help solve your difficulty.


HIGH
TEMPERATURE
WORK SHEET
A simplified form to describe your material problem for study and suggestions
THE INTERNATIONAL NICKEL COMPANY, INC.
DEVELOPMENT and RESEARCH DIVISION
67 Wall Street - New York 5, N. Y.

Send for your copy of this new High-Temperature Work Sheet; it simplifies gathering the full story of your problem.

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See how the maintenance has been engineered out with modern *Life-Lines*

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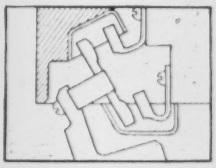
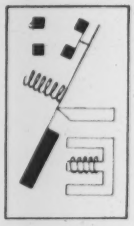
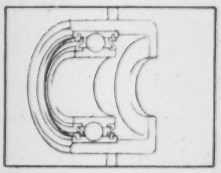


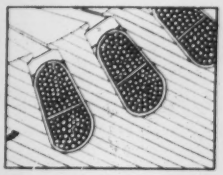
STARTER *Exclusive "De-ion®" Arc Quencher* confines, divides, extinguishes hot arcs fast!



Never Jams. No sliding surfaces to wear—no sticking—no jamming—nothing to wear or replace.



MOTOR *Needs No Lubrication.* Prelubricated factory-sealed bearings eliminate troubles due to over or under lubrication, dust and dirt.



Cuts Winding Burnouts. Pear-shaped slot design eliminates pockets. No corner voids remain to collect dirt, moisture.

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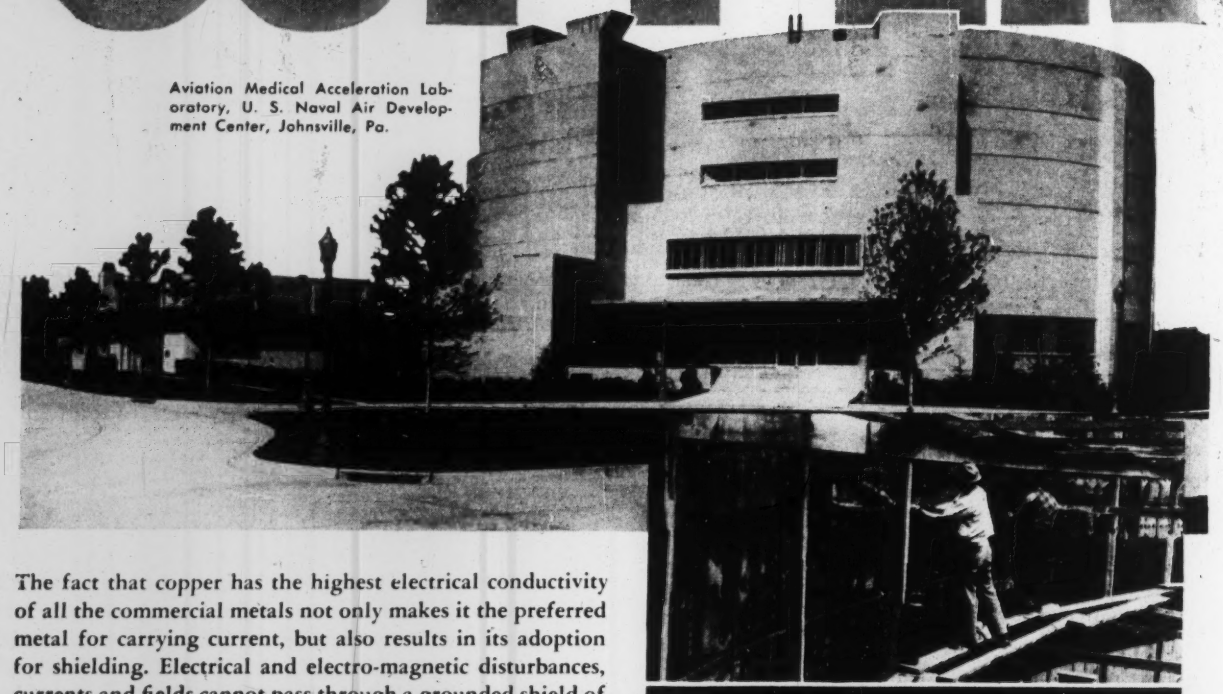
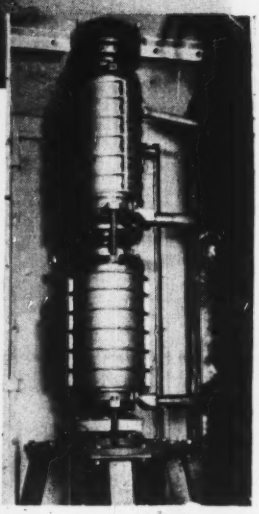


Aviation Medical Acceleration Laboratory, U. S. Naval Air Development Center, Johnsville, Pa.

The fact that copper has the highest electrical conductivity of all the commercial metals not only makes it the preferred metal for carrying current, but also results in its adoption for shielding. Electrical and electro-magnetic disturbances, currents and fields cannot pass through a grounded shield of copper sheet. In this sense, then, copper becomes an insulator. It is widely used for this purpose in laboratories, to assure the accuracy of delicate instruments. A recent spectacular example of such an application is in the Aviation Medical Acceleration Laboratory of the U. S. Naval Air Development Center, Johnsville, Pa. The purpose of the Centrifuge is to test the tolerances of men and animals to the types of acceleration and deceleration produced in military aircraft and to study the physiological conditions which set limits to such tolerances. Recording instruments attached to the subjects are extremely sensitive, but thorough shielding by sheet copper makes it possible to record brain waves without amplification . . . Revere will gladly collaborate with you on scientific and industrial applications of copper and its alloys, and aluminum alloys. See the nearest Revere Sales Office.

Revere Sheet Copper shielding being installed on wall of the Centrifuge chamber by The Howard P. Foley Co., Electrical Contractor, 1630 Pine St., Philadelphia 3, Pa.



A view of the human centrifuge itself. This can produce positive, negative or transverse "G", through accelerations up to 40 times the force of gravity. A great many records are made of each test, including X-ray motion pictures. The subject is observed continually by television.

Upper slip-ring stack—physiological, signal and power. Here copper serves as a conductor.

Official Photographs from U. S. Navy

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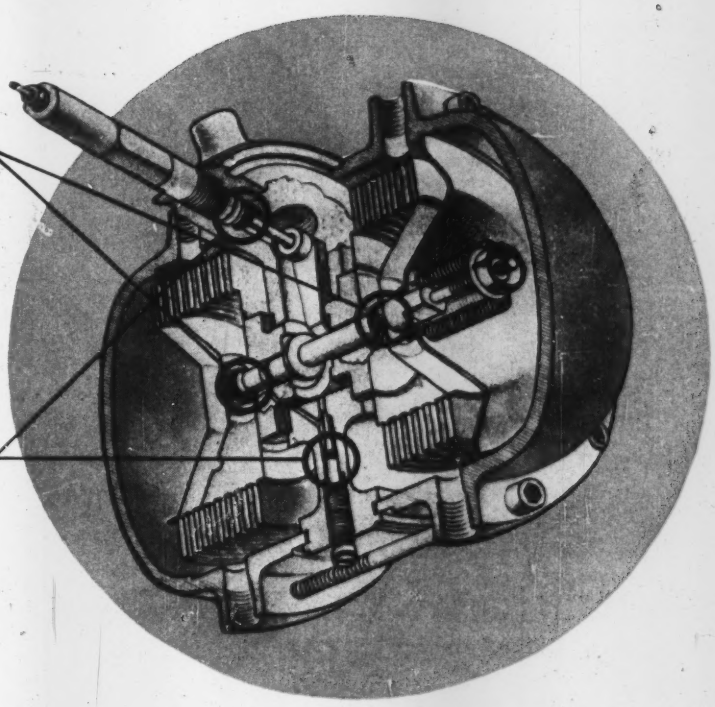
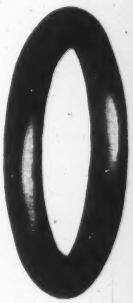
Tight Shut-off here protects the Barton Flow Meter against pressure overloads up to 4500 psi. LINEAR "O" rings on the valve stem make an extremely simple, compact valve that seats tightly . . . gets even tighter as pressure increases—impossible with conventional packings.

Vapor-tight seals here prevent leaks that would destroy the instrument. Several of the points sealed with LINEAR "O" rings are subject to both rotary and reciprocating motion. Others are simply static seals. LINEAR "O" rings permitted considerably more compact and less expensive construction than conventional packings . . . and provided complete safety that could not otherwise have been obtained.



Simple, economical design made possible with Linear "O" Rings



Seal it tight . . . make it small . . . keep design simple and economical. These were the requirements that faced the designer of the Barton Flow Meter. Service conditions were tough, too; pressures up to 4500 psi, temperatures from -20 to 200° F. But on every count, LINEAR "O" rings proved the best answer to sealing problems.

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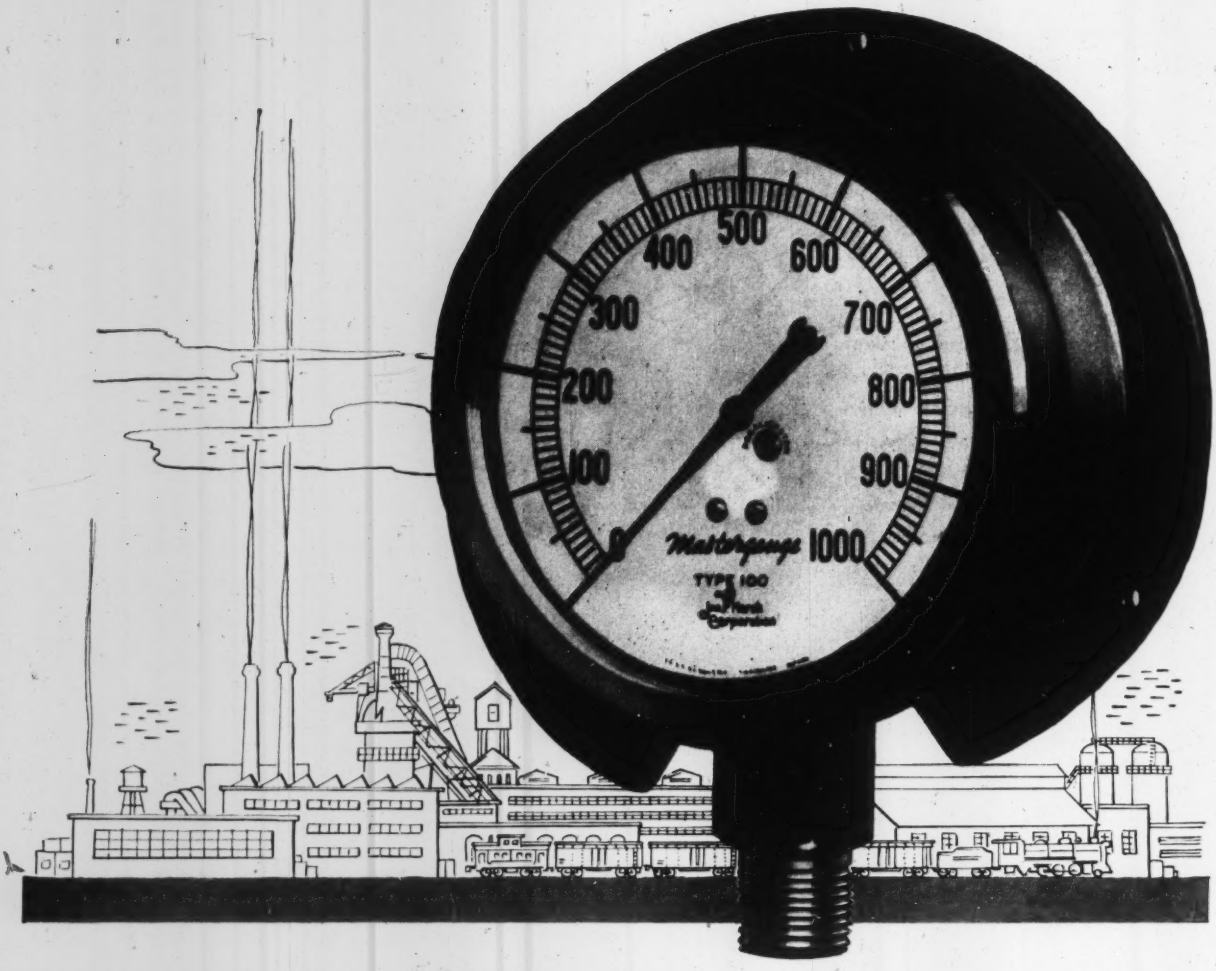
Perhaps your product, too, can be simplified, reduced in size, or made at lower cost through the use of Linear "O" rings. Write or call LINEAR for full information.

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.



More than three quarters of a century beyond errors

Emerson said: "Experience is the label men give to their mistakes." That's a tough way to put it, but the fact remains that wise operating men show respect for this thought by searching out the products of manufacturers whose mistakes are largely *behind* them.

Ours are. While we frankly admit that we have made mistakes, we feel that we can conservatively and modestly say we are at least three quarters of a century beyond the mistake stage.

If you want further proof of this, look at the record of Marsh Gauges and Dial Thermometers. It is a record that has made Marsh instruments "The Standard of Accuracy" throughout industry.

Because Marsh instruments are so respected, they have been given top preference by the leading manufacturers of equipment requiring pressure gauges and dial thermometers. Marsh is the gauge on foremost makes of boilers, pumps, compressors and other products requiring pressure gauges.

Insist on Marsh gauges and thermometers throughout your plant. There is a type for every service.

The Gauge with the "RECALIBRATOR"

Not only the quickest way to correct a gauge; also the best. Best because it corrects for distortion of the bourdon tube — actually does *recalibrate* the gauge.

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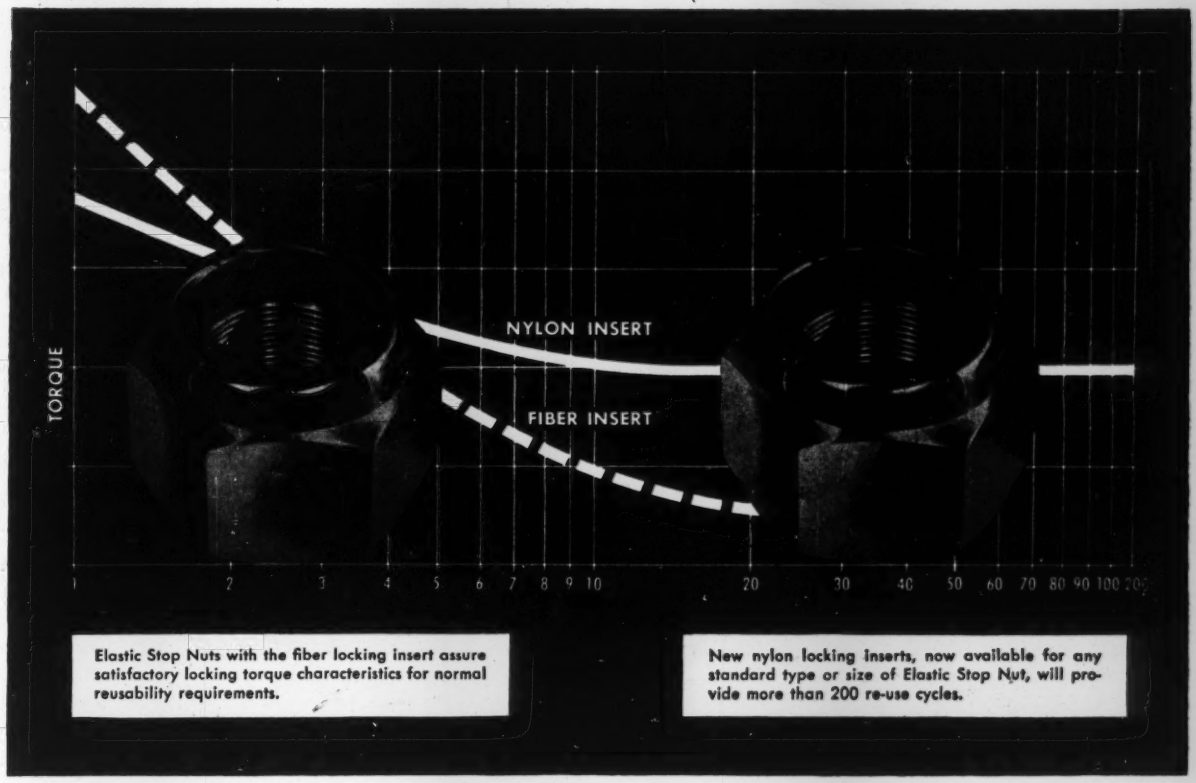

Elastic Stop Nuts with the fiber locking insert assure satisfactory locking torque characteristics for normal reusability requirements.

New nylon locking inserts, now available for any standard type or size of Elastic Stop Nut, will provide more than 200 re-use cycles.

How do you measure Reusability?

UP TO FIFTEEN TIMES?

For assemblies that must be locked in place, Elastic Stop Nuts with fiber locking inserts guarantee a permanently secure grip—plus ample reusability to cover most normal maintenance requirements.

For assemblies that must be disassembled and reassembled five, eight, ten, or more times during normal use, fiber insert Elastic Stop Nuts make the ideal self-locking fastener.

When an Elastic Stop Nut is run on a bolt, the Red Elastic Collar hugs the bolt—actually makes a skin-tight fit against the entire contact length of the threads—and this controlled torque firmly resists vibration or shock. When the Elastic Stop Nut is removed from the bolt, the natural resiliency of the Red Elastic Collar is your guarantee of continuing torque when the nut is reapplied.

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MORE THAN FIFTEEN TIMES?

Now, for assemblies that require constant adjustment or frequent disassembly for checking and maintenance, ESNA offers all standard types and sizes of Elastic Stop Nuts with the new nylon locking inserts.

Reusable up to 200 times with remarkably constant torque characteristics, these new Elastic Stop Nuts offer the one-piece construction, the shock resistance, and the moisture-seal features that many manufacturers now depend upon in the standard Elastic Stop Nuts.

One of these Elastic Stop Nuts is probably the solution to your most troublesome fastener problem. It will pay you to look into the self-locking performance of Elastic Stop Nuts. For information, write for a new, free booklet. **Elastic Stop Nut Corporation of America,** 2330 Vauxhall Road, Union, New Jersey, Dept. N5-111.

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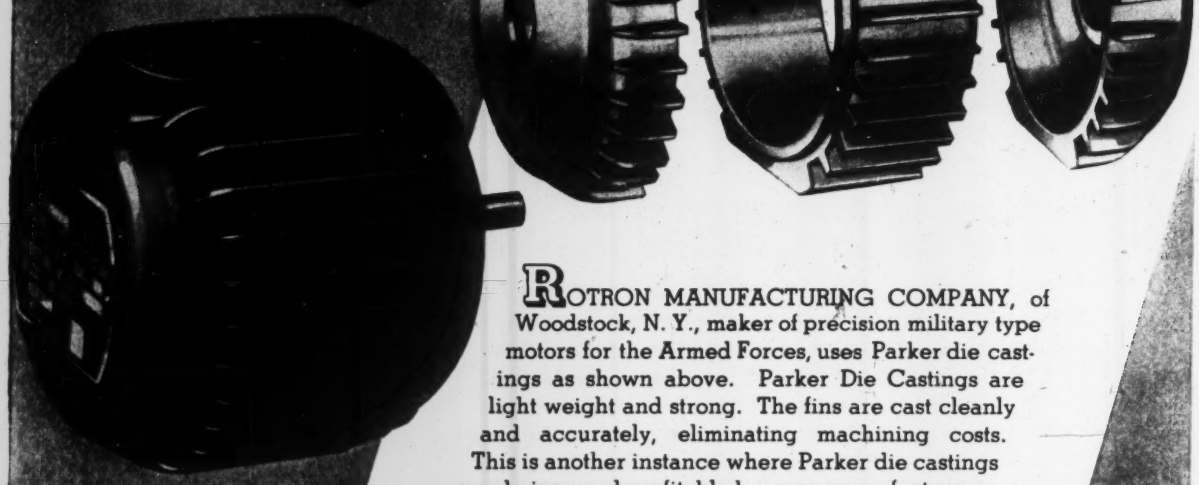
NYLON AND FIBER INSERT TYPES ARE QUALIFIED TO SPEC. AN-N-5

PARKER DIE CAST FINS

save machining cost for ROTRON!



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A nickel bronze gear, teamed with a nickel alloy steel worm, gives you gearing that actually improves with use.

Many years ago, after considerable laboratory and actual field tests of various compositions, The Cleveland Worm and Gear Company . . . specializing for the past 40 years in the production of speed reducers . . . standardized on nickel-tin bronze gears.

Today, many of their drive units which were produced in the early days, are still operating regularly with the original worms and gears . . . which means more than 30 years of useful service.

The reason for this long, trouble-free performance is not hard to find. For nickel improves the strength of standard bronzes and is particularly effective in raising elastic properties . . . increasing shock resistance as much as 25 to 50 percent.

Nickel-containing alloys may meet the exacting demands of your particular equipment or production problems. Write us, today, for counsel and data.

At the present time, the bulk of the nickel produced is being diverted to defense. Through application to the appropriate authorities, nickel is obtainable for the production of nickel alloyed bronzes for many end uses in defense and defense supporting industries.

NICKEL-TIN BRONZE . . . containing approximately 1½% nickel, 10½% tin, a maximum of 0.25% lead, the balance copper . . . is produced by several foundries for gear requirements of The Cleveland Worm and Gear Company of Cleveland 4, Ohio.

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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 75 NUMBER 1

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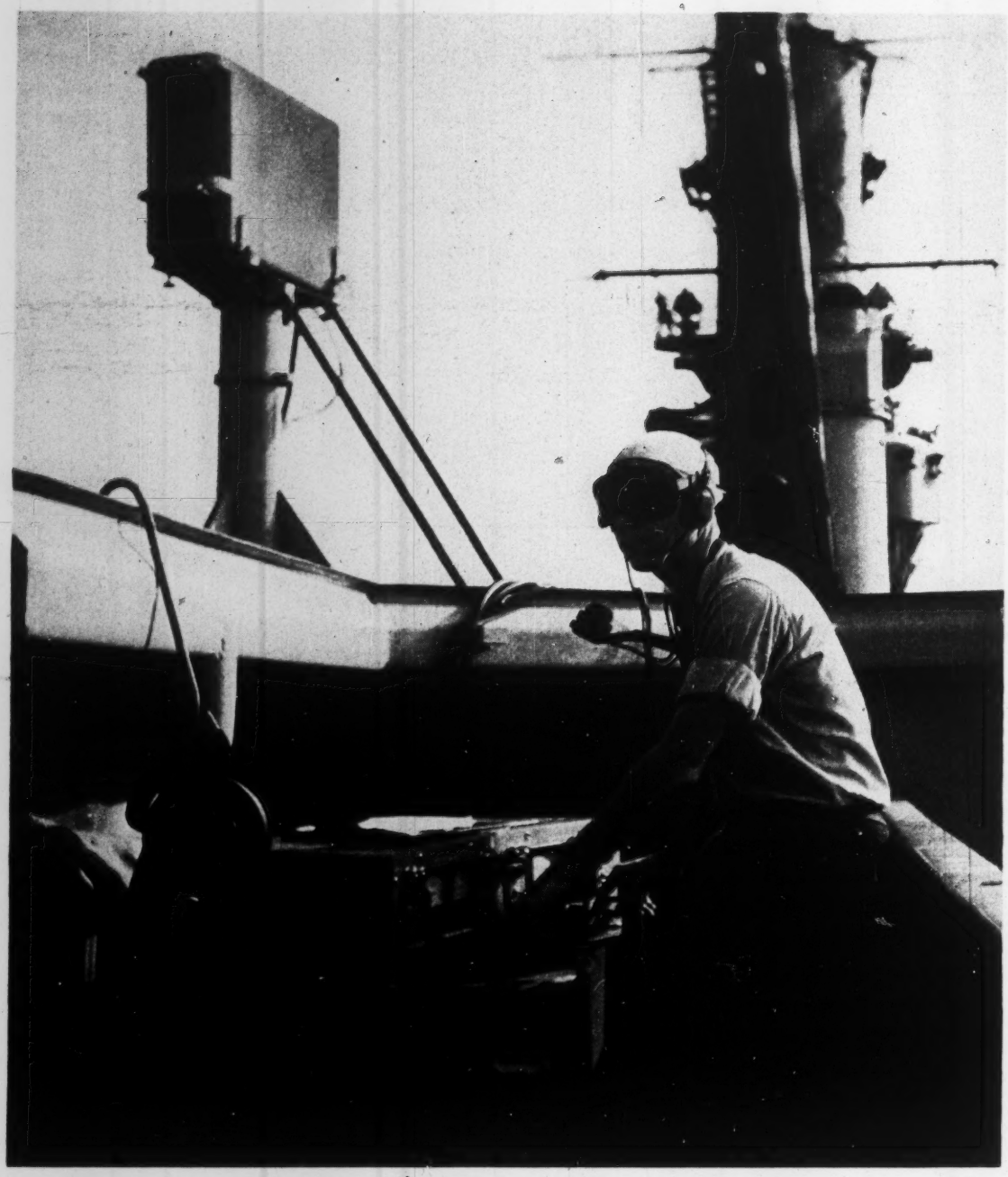

"Trodi"—Touchdown-Rate-of-Descent Indicator

(An electrical-optical brain developed by North American Aviation gives instant data on how fast an airplane "hits the deck" or lands. To seek rate of descent data, Trodi sends out two parallel beams of light, thin vertically and wide horizontally. They are one foot apart. A mirror system on the incoming airplane cuts the top beam, reflecting the light back to a photoelectric cell, which starts an electrical charge into a condenser. The descending airplane then cuts the second and lower beam, reflects it, and stops the charge going into the condenser. The electrical charge stored during the interval between beams is quickly translated by Trodi from voltage to rate of descent in feet per second.)

Describing UNCERTAINTIES *in* SINGLE-SAMPLE EXPERIMENTS

By S. J. KLINE[1] and F. A. McCLINTOCK[2]

Introduction

EVERYONE who uses the results of experiments must sooner or later ask, "How reliable are these results? To how many figures can they be depended upon?" In most cases the experimenter tries to eliminate all errors from his results, but we all know from experience that this happy goal is unattainable. Therefore the honest experimenter must provide the reader with some measure of the reliability of the results.

From the point of view of reliability estimates, experiments fall into two overlapping categories—single-sample and multiple-sample experiments. Ideally, we would like to repeat all measurements enough times using enough observers and enough diverse instruments so that the reliability of the results could be assured by the use of statistics. Experiments in which uncertainties are evaluated by such repetition will be called multiple-sample experiments. The estimation of reliability in multiple-sample experiments has been the subject of many publications. In particular, the American Society for Testing Materials has published a manual (1)[3] covering the presentation of results in controlled multiple-sample experiments. This manual has been available for twenty years and can serve as a standard for the presentation of the type of data covered.

Unfortunately, in most engineering experiments it is not practical to estimate all of the uncertainties of observation by repetition. If for no other reasons, the time required and the costs of operation and personnel are too great to permit repetition of all aspects of large-scale experiments. Experiments of the type in which uncertainties are not found by repetition will be called single-sample experiments.

There is almost nothing in print on methods for the description and analysis of uncertainties in single-sample experiments. The authors are not only unaware of a standard on the subject, but are unaware of any treatment reinforced by data covering an appreciable variety of experiments. Perhaps as a result of this many engineering colleges hardly mention the subject in their undergraduate curricula. The engineering literature in turn reflects this lack of instruction. Even a few of the society test codes which are scrupulous in other matters appear to be incorrect in the calculation of uncertainties. For this reason the authors hope that this presentation will start discussion of a possible standard, that it will stimulate research to provide badly needed data, and that it will encourage educators to review the adequacy of the treatment in their undergraduate curricula.

The scope and, consequently, the importance of single-sample experiments is much greater than at first might be imagined. This is due to four factors all of which tend to lessen the effect of repetition. Consequently, many experiments that appear to be multiple-sample are actually in part single-sample experiments.

The first of these factors was demonstrated by Pearson (2) who showed that observation of scales by a single observer, in general, did not give consistent results even though all extraneous variables appeared to have been removed. In particular, he showed that even a sample of 20 or 30 readings might have a mean value significantly different from the true mean as established by 500 or more samples. In the same paper Pearson also demonstrated that observations of scales by different observers are not necessarily independent due to some unexplained causes as well as to number bias, the tendency to read consistently high or low at certain points. Tuemmler (3) also has noted an apparent difference between the results of various laboratories using equipment of the same design to perform the same tests. The last, and perhaps the most significant factor, since it usually gives rise to the largest errors, is that instruments of different designs, in general, will not give the same results. Hence, if a single instrument is used for a set of observations, some error which is inherent in the instrument will be sampled only once, no matter how many times each reading is repeated.

In single-sample experiments it is inevitable that the statements of reliability will be based in part on estimates. This must be true since by definition statistics cannot be applied to all of the errors. Very often these estimates will be no better than ±50 per cent of the uncertainty; but ±50 per cent may be entirely satisfactory, particularly if the uncertainty is of the order of a few per cent or less of the original data.

A complete method for treatment of uncertainties in a given experiment must provide the answer to three questions: What is a rational way for estimating and describing the uncertainties in the variables? What is a proper method for calculating the propagation of these uncertainties into the results? What must be presented in a report to give a reasonably complete but concise picture of the reliability of the experiment?

Definition of Terms

Before proceeding, let us define certain terms more carefully. By "uncertainty" we mean a possible value the error might have.[4] For a single observation, the error, which is the difference between the true and observed values, is a certain fixed number. But the uncertainty, or what one thinks the error might be, may vary considerably depending upon the particular circumstances of the observation. "Variable" will mean a basic quantity observed directly in the laboratory as opposed to the "result" which is obtained by making corrections to or calculations with the recorded values of the variables. The recorded values of the variables will be called "data." In a few cases, of course, the results will be the same as the data. "Propagation of uncertainty" will mean the way in which uncertainties in the variables affect the uncertainty in the results. The

[1] Assistant Professor, Mechanical Engineering Department, Stanford University, Stanford, Calif.; formerly, Instructor, Mechanical Engineering Department, Massachusetts Institute of Technology, Cambridge, Mass. Jun. ASME.

[2] Assistant Professor, Mechanical Engineering Department, Massachusetts Institute of Technology. Jun. ASME.

[3] Numbers in parentheses refer to the Bibliography at the end of the paper.

[4] This important distinction between error and uncertainty is believed due to Airy (4).

terms standard deviation, mean, and frequency-distribution function will be used in the accepted statistical meanings as given for example by Hoel (5).

UNCERTAINTY DISTRIBUTION

In order to arrive at a rational method for describing the uncertainties in the variables, it is necessary to discuss the sources and nature of the uncertainties. There are many types of errors which can contribute to the uncertainty in each variable.

One useful classification of these errors is as follows: Accidental errors, fixed errors, and mistakes (6, 7). Accidental errors are those varying errors which cause repeated readings to differ without apparent reason. Accidental errors arise from instrument friction and time lag, personal errors, and many other causes. Fixed errors are those which cause repeated readings to to be in error by the same amount without apparent reason. (If a reason were known, presumably a suitable correction would be made and the error eliminated.) Fixed errors arise from such causes as a burr on the lip of a Pitot tube or a lever arm of erroneous length. Mistakes are completely erroneous readings of scales, watches, and so on. Each of these types of errors will be considered in turn.

Accidental errors can be studied by taking repeated observations of the value of a variable. Such a sequence of readings may fall into various patterns, some of which are shown in

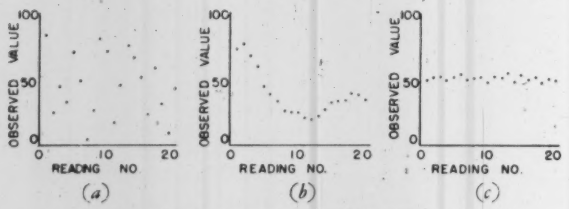

FIG. 1 EXPERIMENTAL OBSERVATIONS

Fig. 1. The sequences shown in Fig. 1(a, b) are uncontrolled or inhomogeneous; there is no telling what the trends are or how far they will go. The sequence of Fig. 1(c) is more predictable; even though there is a variation from one reading to another, the readings all tend to fall in a given region. Such a sequence is called homogeneous. The experiment from which it was obtained is said to be controlled. If a very large number of data are obtained, a frequency-distribution function can be constructed to describe them. The defining characteristic of the frequency-distribution function, $f(v)$, is that the fraction of values lying between v and $v + dv$ is $f(v)dv$. The distribution function corresponding to Fig. 1(c) is shown in Fig. 2. Acci-

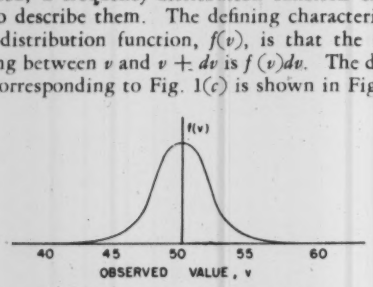

FIG. 2 FREQUENCY DISTRIBUTION

dental errors usually have a frequency distribution similar to that of Fig. 2, in that small errors are more likely than large ones and there is no definite upper limit to the possible size of an error.

The frequency distribution for accidental errors has been assumed to be normal, or Gaussian, by many authors. While this may be true in many cases, it is not true in all. Cases of distribution functions for accidental errors which are non-normal in form (2, 8) et al., are now too well documented to assume that all such distributions will be normal.

In the case of a small number of observations, it is no longer possible to describe the distribution function exactly. Yet it is still possible to make some precise operational statements about the characteristics of the distribution function, using the statistical concept of a confidence limit.

No measure of the scatter of the errors can be obtained from a single-sample experiment. Consequently, the experimenter must rely on his past experience and judgment. The best he can do is make a statement of what he thinks would happen if the experiment were repeated an indefinitely large number of times. It would seem natural to make such a statement in the language of probability and statistics. But statistics are properly based on calculations with measured numbers, while statements regarding single-sample experiments must be based on what one thinks these numbers will be. Hence a statistical description would be misleading. Therefore, the term "uncertainty distribution" will be used instead of frequency distribution.

The uncertainty distribution is the distribution of errors which the experimenter believes would be found in a given variable if the variable were sampled a great many times. The uncertainty distribution caused by accidental errors could be measured by repeated readings of the variable in question. The uncertainty distribution then would be exactly the same as the frequency distribution. Thus the existing frequency distributions for accidental errors can be used to determine what the shape of uncertainty distributions for accidental errors should be.

The few available frequency distributions indicate that the uncertainty distribution caused by accidental errors should have a shape similar to the frequency distribution shown in Fig. 2. Therefore its general characteristics are also the same; namely, small errors are more likely than large errors, plus and minus errors are about equally likely, and no finite maximum error exists.

A close examination of fixed errors shows that the classification of errors as accidental and fixed is really a relative matter. As an example, consider the use of a thermocouple and precision potentiometer to measure furnace temperature. Errors may result from variations in temperature within the furnace both in time and space, from the effect of the thermocouple on the local temperature, from incorrect calibration of the wire or potentiometer, from deterioration of the wire or drift of the potentiometer-battery calibration during use, and from personal errors in balancing and reading the potentiometer. An examination of these errors shows that which errors are called fixed and which are called accidental depends largely on the scope of the experiment. If one observer, using one thermocouple and one potentiometer, were to make readings of temperature at one point, then almost all of the errors must be considered fixed even if the reading were taken many times. However, if several observers, using several different types of temperature-measuring devices, measured the temperature repeatedly at a given point, almost all of the errors could be called accidental. If the same type of apparatus must be used by all observers, a fixed error may remain.

For example, if only one thermocouple installation could be used in the foregoing experiment an error due to the distortion of the temperature field by the thermocouple will not be sampled. Such errors can be estimated by theoretical means, and the uncertainty in these calculations can be thought of as having an uncertainty distribution. Thus the fixed errors have an uncertainty distribution which can be visualized in terms of calculations and the use of more instruments and observers. Consequently, the uncertainty distribution developed in connection with the uncertainties resulting from accidental errors

can be applied directly to the uncertainties which result from fixed errors. The shape of the uncertainty distribution due to fixed errors is also believed to be similar to Fig. 2.

Mistakes are those errors which result from completely erroneous readings of watches, scales, and so on. These errors, in general, will be discarded by a careful observer if they are very large. Consequently, small errors are more likely than large ones, positive and negative errors are about equally likely, and no finite maximum error can be stated. Although the errors tend to occur in discrete steps, they do have an uncertainty distribution which can be visualized in terms of the use of many observers and scale intervals.

The entire error in a given reading due to all of the causes mentioned has no distribution function. It is just a certain finite number. On the other hand, the entire uncertainty or lack of knowledge about the value of a reading can be described completely in terms of an uncertainty distribution since each of its components can be described in this way. However, there is insufficient knowledge of uncertainties to warrant the use of a complete uncertainty distribution for each variable. In addition, the distribution would be too cumbersome for routine use and would require difficult if not impossible mathematics for the calculation of the uncertainties in the results. Some shorthand notation is needed which is consistent both with the concept of the uncertainty distribution outlined and with the state of the experimenter's knowledge of the uncertainties, and yet which is simple enough for routine use.

UNCERTAINTY INTERVAL FOR A VARIABLE

A satisfactory notation for the uncertainty of a variable must include a statement of the best estimate of the true value as well as a statement about the magnitude of the error in the estimate. The best estimate of the true value is usually described by giving the mean of the readings.

A simple but adequate description of the error in the estimate is more difficult to frame. In the case of frequency distributions, the statistician often uses the standard deviation. But use of a standard deviation to describe uncertainties has two distinct disadvantages. (*a*) For nearly normal distributions, it describes an interval such that the odds are approximately 2 to 1 that the error in a particular reading will lie inside the interval. However, the experimenter usually wants his odds to be at least 10 or 20 to 1, rather than 2 to 1. (*b*) It would be misleading to use the term standard deviation which connotes a root-mean-square value calculated from actual measured numbers because in single-sample experiments the numbers must be estimated.

Another measure of scatter sometimes employed is the range. This measure has been employed in some of the existing literature under the name of "maximum error." In the present nomenclature the maximum error would be called the "maximum uncertainty." This concept may have meaning to a manufacturer who must achieve complete interchangeability of parts. In critical manufacturing cases 100 per cent inspection is often used to force a maximum error.[5] But in the case of experimental uncertainty 100 per cent inspection cannot be applied. If just one of the great number of causes for error in a given variable has an uncertainty distribution with very long tails, then the final uncertainty distribution also must have long tails. Since every sampled distribution known to the authors has long tails, it is most unlikely that any uncertainty distribution for the entire error in a given variable can be described properly by a maximum uncertainty. One might argue that there is a maximum value of the uncertainty which the error will never exceed; but even granting this, a rigorous interpretation of the "never" almost always leads to values of the uncertainty which make the experiment unacceptable.

Another method of notation for describing a distribution which is better suited for description of uncertainty distributions is to specify an interval based on certain odds.

For example, the distribution of Fig. 2 indicates that the odds are roughly 20 to 1 that any given reading will lie within ±4 of the mean of the distribution. Conversely, if only the value of a single reading is known, the position of the mean can be described by "20 to 1 the mean of the distribution lies within ±4 of the reading." The odds the experimenter would be willing to wager on his estimate of where the true value lies would depend on how large the interval was made.

In the case cited, for example, he would be willing to wager only 1 to 2 that the true value lies within ±1 of a given reading, but he would be willing to bet 20 to 1 that it lies within ±4, or 100 to 1 that it lies within ±10. This method of description is flexible in that the experimenter can set his odds to conform with the standards of reliability required by any given experiment. A complete description of the uncertainty distribution could be given by the statement of the odds associated with all possible intervals. But a statement of just one interval is all that is justified by our limited knowledge and it does provide a reasonable index of the reliability.

Considering the various factors just discussed, the authors believe that a good concise way to describe the uncertainty in each variable is to specify the mean of the readings and an uncertainty interval based on specified odds. Representing the mean by m (arithmetic mean of observed values), the uncertainty interval by w, and the odds by b, this becomes

$$m \pm w, (b \text{ to } 1) \quad [1]$$

As an example one might give

$$\text{Pressure} = 50.2 \pm 0.5 \text{ psia } (20 \text{ to } 1)$$

This states that the best value for the pressure is believed to be 50.2 psia and the odds are 20 to 1 that the true value lies within ±0.5 psia of this best estimate. The uncertainty interval, which is denoted by w, is not a variable but a fixed value selected so that the experimenter would be willing to wager b to 1 that the error is less than w.

Determination of the actual value of the uncertainty interval based on given odds is one of the jobs of the experimenter. As already noted, at least some of these intervals will have to be based on estimates rather than experiments, and the estimates often may be no better than ±50 per cent. Despite this, the experimenter owes it to himself and to his readers to go ahead and do the best he can; no one else is in an equally good position to make the required estimates which are essential to rational design and to interpretation of the results.

Such estimates are, of course, not pure guesses. Factors such as instrument backlash, sensitivity, and fluctuation, as well as the accuracy of the basic theory of operation of the instrument, sometimes can be accounted for. Calibration of the instrument against some type of standard is sometimes available, and experience based on prior experiments or auxiliary experiments can be used. This part of the subject is covered already in the standard textbooks on instrumentation and is too detailed in nature for adequate treatment here. Readers desiring further information should see (6, 8, 10) and other texts, manufacturers' catalogs, and the literature of their specialty.

Equation [1] together with the foregoing discussion gives a method by which the experimenter can describe the uncertainties in each of the basic variables in what the authors believe to be a sufficiently accurate and simple manner for routine use. It is then necessary to determine how these uncertainties propagate into the results.

[5] Even in these cases we know from experience that assembly sometimes fails. An enlightening discussion of this subject including cost effects is given by Pike and Silverberg (9).

UNCERTAINTY INTERVAL IN THE RESULT

Let the result R be a function of n independent variables, $v_1, v_2, \ldots v_n$

$$R = R(v_1, v_2 \ldots\ldots v_n) \ldots\ldots\ldots\ldots [2]$$

For small variations in the variables, this relation can be expressed in linear form as

$$\delta R = \frac{\partial R}{\partial v_1}\delta v_1 + \frac{\partial R}{\partial v_2}\delta v_2 + \ldots\ldots + \frac{\partial R}{\partial v_n}\delta v_n \quad [3]$$

The uncertainties in the variables v_i are represented completely by an uncertainty distribution but can be adequately described by uncertainty intervals w_i based on certain odds. Therefore we must examine how to find the uncertainty interval for the result w_R based on essentially the same odds as the intervals for each of the variables. Certain theorems of statistics concerning the way in which frequency distributions combine will be helpful in finding a reasonable value for w_R.

Theorem 1. If R is a linear function of n independent variables, and if the maximum deviation of the ith variable from its mean is $(\pm\delta v_i)_{max}$ then the maximum deviation of R from its mean value is given by

$$\delta R_{max} = \left|\frac{\partial R}{\partial v_1}\delta v_{1_{max}}\right| + \left|\frac{\partial R}{\partial v_2}\delta v_{2_{max}}\right| + \ldots\ldots + \left|\frac{\partial R}{\partial v_n}\delta v_{n_{max}}\right| \quad [4]$$

Equation [4] might be used as an approximation for calculating the uncertainty interval in the result by simply substituting w_i for v_i. This yields

$$w_R = \left|\frac{\partial R}{\partial v_1}w_1\right| + \left|\frac{\partial R}{\partial v_2}w_2\right| + \ldots\ldots + \left|\frac{\partial R}{\partial v_n}w_n\right| \quad [5]$$

This equation will be referred to as the linear equation. If it is employed, the odds on the uncertainty interval in the result will be much higher than the odds used in the variables. This is because of the fact that the errors in each variable can have a range of values, and it is quite unlikely that all of them will have the most adverse values at the same time.

Theorem 2. If R is a linear function of n independent variables, each of which is distributed with a standard deviation σ_i, then the standard deviation of R is given by

$$\sigma_R = \left[\left(\frac{\partial R}{\partial v_1}\right)^2\sigma^2_1 + \left(\frac{\partial R}{\partial v_2}\right)^2\sigma^2_2 + \ldots\ldots + (\partial R/\partial v_n)^2\sigma^2_n\right]^{1/2} \ldots\ldots [6]$$

We have seen, however, that the best measure of uncertainty is neither the maximum value nor the standard deviation, but some interval based on certain odds. For the special case in which the variables are distributed normally the distribution of the result also will be normal, and the following theorem applies:

Theorem 3. If R is a linear function of n independent variables, each of which is normally distributed, then the relation between the interval for the variables w_i, and the interval for the result w_R, which gives the same odds for each of the variables and for the result is

$$w_R = \left[\left(\frac{\partial R}{\partial v_1}w_1\right)^2 + \left(\frac{\partial R}{\partial v_2}w_2\right) + \ldots\ldots + \left(\frac{\partial R}{\partial v_n}w_n\right)^2\right]^{1/2} \ldots [7]$$

Equation [7] might be used directly as an approximation for calculating the uncertainty interval in the result. Equation [7] will be referred to as the second-power equation.

Examples were calculated to compare the accuracy of the linear and second-power equations for predicting the appropriate interval in the result in the case of different distributions.

Three different frequency-distribution functions were chosen, one normal, one corresponding to one wave length of a sine curve, and the last corresponding to an isosceles triangle. Since the latter two distributions have finite limits, and are considerably less normal than the distributions usually considered in connection with uncertainties, they constitute a severe test of the generality of the second-power equation. Odds of 9 to 1, 19 to 1, and 99 to 1, were chosen as being of interest in experimental engineering work. The mathematics employed in calculating the exact distribution function of the result are outlined in the Appendix.

For Table 1 the result was considered to be proportional to the sum of two variables. According to this table, the second-power equation gives odds nearer to the desired odds in every case. The second-power equation predicts the uncertainty intervals for the result to within ±10 per cent of the correct value, while the linear equation predicts uncertainty intervals varying from the correct value by as much as 40 per cent.

The difference between intervals given by the linear and second-power equations increases as the square root of the number of variables if each variable has about equal effect on the result.

For Table 2 the result was taken to be proportional to the sum of an infinite number of variables. This table shows even more clearly the superiority of the second-power equation. The odds given by the second-power equation for the uncertainty interval in the result are still reasonable while the linear equation gives infinite odds. The error in the interval introduced by use of the second-power equation increases to no more than 15 per cent, while the error due to use of the linear equation becomes infinite. Since the state of knowledge of uncertainty intervals for the variables is of the order of ±50 per cent, it seems entirely reasonable to use the second-power equation for the calculation of the uncertainty interval for the result.

The second-power equation, Equation [7], is also of importance in planning instrumentation. It applies in this sense both to single- and multiple-sample experiments since statistics cannot be applied to a multiple-sample experiment in advance of the tests. It shows that uncertainties in individual variables add into the uncertainty in the result by the square. Consequently, the effect of large uncertainties in the variables is emphasized, and a given reduction in a large uncertainty is far more important than the same numerical reduction in a small uncertainty. The second-power equation is thus a useful tool in the selection of instrumentation for experiments.

EXAMPLE

As an illustration of the ideas presented in the foregoing, consider the measurement of velocity with a Pitot tube in an air stream. If c denotes the velocity, Δp the pressure difference between the Pitot tube and the atmosphere, and p_a and T_a the pressure and temperature of the air, respectively, then Bernoulli's equation and the perfect-gas equation of state give

$$c = \sqrt{\frac{2(\Delta p)RT_a g_0}{p_a}} \ldots\ldots\ldots\ldots [8]$$

Here the result is the velocity and the variables are Δp, p_a, and T_a. Even in this apparently simple measurement there are a great many possible sources of error which give rise to the uncertainties. Some of them are alignment of the Pitot tube in the flow, leaks in the pressure tubing, changes in bore, or differences in surface condition of the manometer measuring the

TABLE 1 DISTRIBUTION OF THE RESULT: $R = (v_1 + v_2)/\sqrt{2}$

	Normal			Sinusoidal			Triangular		
Distribution of variable	$f(v) = \frac{1}{\sqrt{2\pi}} e^{-v^2/2}$ for all v			Define $A = \sqrt{\pi^2/3 - 2}$; then $f(v) = A(1 + \cos Av)/2\pi$ for $\lvert v\rvert \le \pi/A$			$f(v) = 1/\sqrt{6} - \lvert v\rvert/6$ for $\lvert v\rvert \le \sqrt{6}$		
Distribution of result	$f(R) = \frac{1}{\sqrt{2\pi}} e^{-R^2/2}$ for all R			$f(R) = \frac{A}{2\pi^2\sqrt{2}}[(3/2)\sin\sqrt{2}AR + (\pi - AR/\sqrt{2})(2 + \cos\sqrt{2}AR)]$ for $0 \le \lvert R\rvert \le \sqrt{2}\pi/A$			$f(R) = \frac{2}{3\sqrt{3}} - \frac{R^2}{3\sqrt{3}} + \frac{\lvert R\rvert^3}{18}$ for $0 \le \lvert R\rvert \le \sqrt{3}$ and $f(R) = \frac{4}{3\sqrt{3}} - \frac{2\lvert R\rvert}{3} + \frac{R^2}{3\sqrt{3}} - \frac{\lvert R\rvert^3}{54}$ for $\sqrt{3} \le \lvert R\rvert \le 2\sqrt{3}$		
Desired odds	9:1	19:1	99:1	9:1	19:1	99:1	9:1	19:1	99:1
Actual odds for interval given by second-power equation	9:1	19:1	99:1	8.3:1	16.6:1	51:1	9.4:1	17.2:1	42:1
Actual odds for interval given by linear equation	49:1	178:1	70:1	54:1	257:1	6620:1	75:1	300:1	7500:1
Correct interval of result for desired odds	1.64	1.96	2.58	1.68	1.95	2.44	1.66	1.94	2.44
Interval given by second-power equation	1.64	1.96	2.58	1.62	1.88	2.26	1.68	1.90	2.20
Interval given by linear equation	2.32	2.77	3.64	2.29	2.66	3.20	2.37	2.69	3.12

TABLE 2 DISTRIBUTION OF THE RESULT: $R = \lim_{n\to\infty} (v_1 + v_2 + \ldots + v_n)/\sqrt{n}$

	Normal			Sinusoidal			Triangular		
Distribution of variable	$f(v) = \frac{1}{\sqrt{2\pi}} e^{-v^2/2}$ for all v			Define $A = \sqrt{\pi^2/3 - 2}$; then $f(v) = A(1 + \cos Av)/2\pi$ for $\lvert v\rvert \le \pi/A$			$f(v) = 1/\sqrt{6} - \lvert v\rvert/6$ for $\lvert v\rvert \le \sqrt{6}$		
Distribution of result	$f(R) = \frac{1}{\sqrt{2\pi}} e^{-R^2/2}$ for all R			$f(R) = \frac{1}{\sqrt{2\pi}} e^{-R^2/2}$ for all R			$f(R) = \frac{1}{\sqrt{2\pi}} e^{-R^2/2}$ for all R		
Desired odds	9:1	19:1	99:1	9:1	19:1	99:1	9:1	19:1	99:1
Actual odds for interval given by second-power equation	9:1	19:1	99:1	8.5:1	15.7:1	41:1	9.6:1	16.4:1	35:1
Actual odds for interval given by linear equation	∞:1	∞:1	∞:1	∞:1	∞:1	∞:1	∞:1	∞:1	∞:1
Correct interval of result for desired odds	1.64	1.96	2.58	1.64	1.96	2.58	1.64	1.96	2.58
Interval given by second-power equation	1.64	1.96	2.58	1.62	1.88	2.26	1.68	1.90	2.20
Interval given by linear equation	∞	∞	∞	∞	∞	∞	∞	∞	∞

pressure difference, fluctuations in atmospheric and stream pressure, and so on. In this case the Mach number must not be too high nor the Reynolds number too low. In either case the assumption of incompressible frictionless flow inherent in Bernoulli's equation is violated.

Let us suppose that the Mach number and the Reynolds number have proper values. In order to use Equation [7] all uncertainty intervals for the variables must be based on the same odds. Twenty to one will be used. If T_a is measured by a calibrated mercury-in-glass thermometer, p_a with a Bourdon gage, and Δp with a U-tube manometer, a description of the readings might be

$\Delta p = 8.0 \pm 0.1$ in. H_2O (20 to 1)
$T_a = 67.4$ F $= 527.1 \pm 0.2$ deg F abs (20 to 1)
$p_a = 14.7 \pm 0.3$ psia (20 to 1)

Evaluating the $(\partial R/\partial v_i)$ terms and substituting into Equation [7]

$$w_R = \left[\frac{1}{4}\frac{2RT_ag_0}{(\Delta p)p_a}(w_{\Delta p})^2 + \frac{1}{4}\frac{2(\Delta p)RT_ag_0}{{p_a}^3}(w_{p_a})^2 + \frac{1}{4}\frac{2(\Delta p)Rg_a}{p_aT_a}(w_{T_a})^2\right]^{1/2} \quad [9]$$

Equation [9] is greatly simplified upon dividing by Equation [8] to nondimensionalize

$$\frac{w_c}{c} = \frac{w_R}{R} = \left[\left(\frac{1}{2}\frac{w_{\Delta p}}{\Delta p}\right)^2 + \left(\frac{1}{2}\frac{w_{p_a}}{p_a}\right)^2 + \left(\frac{1}{2}\frac{w_{T_a}}{T_a}\right)^2\right]^{1/2} \quad [10]$$

This nondimensional form is simpler in most cases. It can

be obtained as shown previously, or alternatively by use of logarithmic differentiation on Equation [8], or by substituting $c + w_R$ for c, $p_a + w_{pa}$ for p_a, and so on, multiplying out and neglecting terms in w^2.

When the numbers are substituted into Equation [10] using consistent units, one obtains

$$w_c/c = 1/2\,[1.08 \times 10^{-4} + 4.15 \times 10^{-4} + 1.44 \times 10^{-7}]^{1/2} = 1.1 \text{ per cent}$$

This calculation illustrates that if the $\partial R/\partial v$ terms are neglected, as is sometimes done, serious errors occur. In this case w_c/c would have been in error by a factor of 2. It also shows that improving the measurement in the temperature would not change w_c/c appreciably, but a 50 per cent reduction in w_c/c could be obtained simply by using a manometer instead of a Bourdon gage to measure p_a. This illustrates the utility of the second-power equation in determining which variables need most attention in improving the accuracy of an experiment.

Presentation of Uncertainties in a Report

The questions, "How should uncertainties in the variables be estimated and described?" and "How do the uncertainties propagate into the results?" have now been discussed and conclusions reached. The answer to the final question, "What should be presented in a report?" cannot be given definitively since it is subject to the demands of space and time as well as the practices of societies and publishers. The authors feel that presentation of uncertainty intervals for the results as found by Equation [7] along with the odds used should be sufficient in most cases. For more elaborate reports the uncertainty intervals assigned to each variable also might be useful.

Conclusion

The method suggested here can be summarized as follows:

1 Describe the uncertainty in each variable as

mean ± uncertainty interval (odds of b to 1).....[1]

2 Compute the uncertainty interval in each result as

$$w_R = \sqrt{\left(\frac{\partial R}{\partial v_1} w_1\right)^2 + \left(\frac{\partial R}{\partial v_2} w_2\right)^2 + \ldots \left(\frac{\partial R}{\partial v_n} w_n\right)^2} \quad [7]$$

3 Present at least the value of w_R and the chosen odds for each result as an integral part of a report or paper.

The value of w_R found in this way will be based on essentially the same odds as the uncertainty intervals in the variables. The only important restriction is that the uncertainties in each of the variables must be independent.

The method thus summarized provides a means for describing and analyzing the uncertainties in single-sample experiments. In this method the actual estimation of the uncertainty intervals must still depend on the judgment of the experimenter. At present this judgment can be acquired only by laboratory experience since data on the total uncertainty interval in most instruments are unavailable. A great many engineering experiments are part single-sample and part multiple-sample.

In such cases the available repeated measurements should be analyzed by statistical methods to supplement the judgment of the experimenter. In either case this method should provide a simple and useful tool by which the experienced investigator can more accurately describe and analyze experimental uncertainty in both the laboratory and design stages of his work.

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APPENDIX

The three different frequency-distribution functions chosen were all assumed to have zero mean and unit standard deviation. The equations for these distributions are presented in the headings of Tables 1 and 2. Outside the regions specified, the frequency-distribution functions are zero.

For Table 1 the result was chosen to be proportional to the sum of two variables

$$R = (v_1 + v_2)/\sqrt{2} \quad [11]$$

The factor $1/\sqrt{2}$ is introduced simply to give the result a standard deviation of unity; it does not affect the comparison between the linear and second-power equations. The frequency-distribution function of this result can be found by evaluating the following integral[6]

$$f(R) = \int f(\sqrt{2}R - v_1)\, f(v_1)\, \sqrt{2}\, dv_1 \quad [12]$$

Calculation of the distribution function of the sum of more than two variables becomes quite tedious. For the limiting case of an infinite number of variables, however, the resulting distribution is normal,[7] and a comparison becomes easy to make. The result will have a unit standard deviation if one takes R to be

$$R = \lim_{n \to \infty} (v_1 + v_2 + \ldots + v_n)/\sqrt{n} \quad [13]$$

[6] Reference (11), pp. 40–48.
[7] Ibid., p. 108.

FOREST-PRODUCTS INDUSTRIES *of the* UNITED STATES

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THE BEGINNINGS OF INDUSTRY

THE first industrial activity in which the early colonists of North America were engaged was the manufacture of forest products. The records of the Virginia Company show that in 1608 there was sent to England from Jamestown a shipment of "pitch, tarre, clapboard, and waynscot," a tiny cargo, perhaps, but one that was to become historic as representing the first products of American manufacture. The first sawmill in Virginia was followed within a few years by others in that colony. A mill is supposed to have been set up at York, Maine, in 1623, and the establishment in 1634 of a sawmill to cut white pine at South Berwick, Maine, is well authenticated. From these humble beginnings developed the white-pine industry that was to dominate the American lumber scene for nearly three centuries.

The primeval forest in which the colonists were settled was the natural resource for our nation's first industry. And what a resource it was! Extending from the Atlantic Coast westward to the Mississippi River, and even beyond, was an unbroken forest of an immensity that staggered the imagination of the settler. In the North the majestic white pine dominated the forests; in the Central States, the mixed hardwood stands of tall, clear-boled oak, black walnut, hickory, ash, and yellow poplar surpassed in size and quality anything known to the settlers from England and Europe; and in the South the yellow pines ranged to the west seemingly without limit. Unknown to the New England and Virginia colonists were the great parklike stands of ponderosa pine that characterized the Rocky Mountain and inland western forests from Canada to Mexico. Neither did they know of the unbelievably dense and magnificent coniferous forests that clothed the slopes west of the Cascade Mountains in Washington and Oregon. Further south in coastal California, the giant redwoods, whose grandeur surpasses description, had been standing for 2000 years before the first sawmill was set up at Jamestown.

These continental forests originally covered 820 million acres and are estimated to have contained over 5 thousand billion board feet of potential lumber. Is it little wonder that to the early settler the forest seemed inexhaustible? The forest was not only the source of lumber and fuel, providing shelter and warmth for the colonist and his descendants, but its removal was necessary to provide room for settlement and agriculture. Thousands upon thousands of acres of prime timber in the northeast and central hardwood regions were cleared and the logs burned simply as the most convenient means for their disposal.

At first the inroads of the lumberman upon the forest were scarcely noticeable. The early mills were of the sash-saw type, a water-powered adaptation of the older man-powered pit saw. The saw blade was held rigidly in a vertical frame and was driven with an up-and-down motion while the log was fed slowly past the saw. With good luck a mill might produce 500 ft per day. Stanley Horn[1] describes the operation of such a sawmill: "Daniel Webster's father had a sawmill in New Hampshire which was of this leisurely sash-saw type. The immortal Daniel—who unblushingly admitted his aversion to physical labor—stated that in his boyhood he liked nothing better than to be assigned the task of operating this mill. When he had . . . . . started the saw he had sixteen minutes for rest or reading before the saw had worried its way through the length of the log and again required attention."

Logging methods to supply the early mills also were primitive. The first timber cut was usually on the banks of streams or adjacent slopes from which the trees were hand-logged by ax and manpower and floated to the mill. Later on as this most readily accessible timber was cut off, it became necessary to skid logs to the streams by means of teams of horses or oxen. With the spreading out of settlement through colonial America, the village sawmill was accompanied by other manufactures—furniture shops, coopers, wagon works, and boatbuilders. These were the beginnings of the woodworking industry, which, like the lumber industry, was to contribute importantly to the conversion, within the span of three hundred years, of a continental wilderness to the most highly developed industrial and agricultural economy the world has ever known.

THE MIGRATORY PERIOD

Throughout the Colonial period lumber milling was a local industry, supplying materials for local needs. Growing demands for lumber, however, led to the subsequent development of large concentrations of mills at the mouths of many of the rivers along the Atlantic seaboard to which logs were floated from the inland forests. One of the outstanding centers was the Machias River in eastern Maine, where for 21 miles the banks literally were lined solidly with sawmills, timber shipping docks, and shipbuilding yards. The leisurely water-powered sash saw remained the means of production until some time after 1820, when the steam-operated circular saw was introduced, to be followed in the 1880's, in all of the larger mills by the still faster band saw. The faster production of these mills was able to meet the increasing demands for building material for westward expansion, but it also brought about the depletion of the standing timber then accessible to the mills. From the Penobscot, the Machias, and the Kennebec in Maine, the industry began its trek westward, first to the upper valleys of the Connecticut, then on to the Hudson, the Susquehanna, the Ohio, and beyond.

Maine led all the states in lumber production until 1850, when the center of production shifted to New York. By 1860 the lead in production was taken by Pennsylvania, and by 1873 had passed on to Michigan. The end of the white-pine era was reached in the first decade of the twentieth century with the virtual exhaustion of the once magnificent stands of Michigan, Wisconsin, and Minnesota.

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[1] "This Fascinating Lumber Business," by Stanley F. Horn, Bobbs-Merrill Company, Inc., Indianapolis, Ind., 1951.

Throughout this period the tempo of production was increasing constantly. Although many mills were dismantled in the process of migration, others remained in operation long after the main tide of industry had rolled on. It is interesting to note that the mills of the state of Maine, far from being rusted and forgotten, actually attained their peak of production in 1909. In that year Maine, although far from being the leading state, produced more than 1 billion feet of lumber. As a general rule, too, the wood-using industries—the furniture factories and the woodworking shops—were not so easily uprooted and continued to operate near their established markets.

The history of the nation's total lumber production during this period measures the growth of the industry and the dependence of the rapidly expanding economy upon the forest resource. By 1850 total annual lumber production exceeded 5 billion board feet. This had climbed to nearly 13 billion by 1870, 27 billion by 1890, and 35 billion by 1900. The all-time peak of lumber production was reached in 1909, following the reign of "King White Pine," when the nation's mills produced nearly 45 billion board feet of lumber. By that time the advancing forces of industry had split, one branch moving into the pine forests of the South and the other to the Douglas-fir region of the West Coast. Washington and Louisiana had become the leading individual centers of production, and nearly half of the total production in 1909 was contributed by the southern states. The end of the migration was in sight. The lumberman had reached the last frontiers of virgin timber in the United States.

Under the driving forces that demanded constantly increasing production the lumber industry had grown by the turn of the century to the stature of a giant. Logging methods had evolved to fit the characteristics of each region. In the North, winter logging with sleds to facilitate skidding was generally practiced, and stream driving reached the height of its development there. In the flat pine lands of the South, pairs of high wheels were at first used to elevate one end of a load of logs while skidding them. Mechanical power had been introduced to the Maine woods with the steam log hauler which pulled a train of loaded sleds or wagons to the log landing. The logging railroad hastened the onslaught upon the white pine in the Lake States, and cable skidding by steam power, that was later to enable the logger in the Pacific Northwest to harvest the massive logs of that region with relative ease, was also first introduced in the era of Lake States logging. Each of these developments was carried on by the loggers as they moved into new regions and continued to undergo improvements leading toward faster and cheaper production.

Manufacturing plants also had evolved under the American genius for development of machinery and production. The records indicate that a circular saw was hammered out by Benjamin Cummins of Burtonville, N. Y., in 1820. Although displaced in the larger mills by the later development of the band saw, the circular saw represented a vast improvement over its predecessors and is still used in the great majority of small sawmills operating in the United States today. Even in the larger band-saw mill, of course, the circular saw performs many important functions in edging and trimming. The great majority of cutting-up operations in woodworking plants that employ lumber as a raw material are also performed on circular saws. Although the band saw had been invented much earlier it was not until about 1870, when J. R. Hoffman first succeeded in demonstrating its practicability in a mill at Fort Wayne, Ind., that this new development came to be commonly accepted by the industry.

The introduction of the band mill with its possibilities for new levels of high production led to mills of increasing size. By using two or more band mills within a single plant, and co-ordinating these with gang saws and resaws, plants producing 100,000 ft or more of lumber per day came into existence. One of the largest operating in northern Minnesota employed five band head saws. The first mill producing 1,000,000 ft of lumber per day was built at Bogalusa, La., in 1909, by the Great Southern Lumber Company, a capacity that has been duplicated or exceeded by only a few mills built subsequently on the West Coast. As the sawmill grew in complexity, the efficiency of lumber manufacture was greatly improved by the mechanization of log and lumber movement by means of log kickers, steam niggers, log turners, live rollers, and conveyer chains.

For virtually 300 years the American lumberman's philosophy was to "cut out and get out." He has been indicted for wasting our natural resource, and for the "ghost" towns, and devastation that remained in his wake. Looked at from the standpoint of a planned economy, the saga of the lumber industry may well be regarded as an inexcusable American tragedy.

But there is another side to the story. The great migration of the industry occurred during an era in which new frontiers were always beckoning. The free-land philosophy was as characteristically American as is free enterprise. The abandonment of eastern farm land for the richer lands of the Middle West was a result of the same economic forces that drove the lumber industry onward to new timber. The cutting of timber opened up new lands for settlement which in turn created a demand for more lumber. The rapidly growing population and an increasing per-capita consumption of lumber that attained a peak of more than 500 fbm annually in the first decade of the new century, provided the incentive for mass production. Competition necessitated low-cost volume production which was supplied through larger and more efficient units. As long as cheap timber lay ahead to the south and west, and was made increasingly available through the rapid extension of water and rail transportation, it was a competitive threat to the production of older regions and exerted a powerful influence on the larger producers to liquidate their operations. Methods of debt retirement then current in timber financing also played their part in hastening the day of timber exhaustion by requiring heavy annual payments which could be met only by increasing production. The situation has been summed up by W. B. Greeley:[2]

"The competitive quest for the cheapest lumber constantly drove manufacturers into new stands of timber with the latest and most efficient mills."

Responding to these incentives the lumber industry supplied a building material of high quality at low cost that opened up the West; through its employment it speeded up the settlement of the land; and its accumulated wealth provided capital for the economic development of the new country. To quote Colonel Greeley again: "We traded a large part of our virgin-forest heritage for national expansion to the Pacific in two generations."

THE TRANSITION TO STABILITY

When the Lake States and eastern lumbermen turned the full power of their skills and machines to the South and Pacific Coast in the 1890's, there followed two decades of the most rapid exploitation of timber in the history of the American industry. For 10 years following 1904, annual production of lumber exceeded 40 billion board feet, nearly half of this total coming from the South. By 1920 production had dropped to 34 billion feet, 75 per cent originating from southern and Pacific Coast mills. The business depression hit the lumber industry hard and in 1930 production had dropped to 26 billion

[2] "Forests and Men," by W. B. Greeley, Doubleday and Company Inc., Garden City, N. Y., 1951.

feet, and by 1932 to a low of 10 billion feet. By 1940 lumber production had climbed back to a total of 29 billion feet, and since has fluctuated between 28 and 36 billion feet per year. Together, the South and West contribute over 80 per cent to this total.

From the very beginning lumber has been only one of many products yielded by the forest. Ship masts which consisted of white-pine trees topped and stripped of their branches were among the first of these. Although steadily declining over the years, wood fuel still constitutes a sizable percentage of the annual timber harvest. Posts; poles, piling, and other roundwood products; hewed railroad crossties; bolts used in cooperage and other wood manufacture; and wood used in distillation are among the other forms of wood utilization. Two forms of manufacture, however, are deserving of special mention.

The manufacture of pulp and paper from wood had its beginning just prior to the Civil War. From that beginning the growth of the industry has been phenomenal, and today the pulp and paper industry is ranked among the top ten of the nation in terms of value of its products. At first only spruce and aspen were considered suitable for pulping, then the balsam firs and hemlock. As new processes were developed, the resinous southern pines were discovered to yield pulp products of excellent strength, and later even the denser hardwoods were found to be valuable as a source of fiber and cellulose. Today the pulp and paper industry is operating in all of the major forest regions and its annual wood requirements currently amount to nearly 20 million cords (1660 million cubic feet.)

The veneer and plywood industry is another lusty offspring of the forest. Since the introduction of the rotary veneer lathe the production of veneer and its conversion to plywood have undergone an expansion which is surpassed only by the growth of the pulp and paper industry. Prior to 1900, veneer had been produced chiefly by sawing and slicing but these methods were not adapted to the mass production of which the veneer lathe was capable. The veneer and plywood industry really consists of two distinct industries—hardwood and softwood.

Hardwood veneers of a great many kinds, both foreign and domestic, are used as face plies for plywood in furniture and decorative paneling. A much greater volume of hardwood veneer is commercial or utility veneer used as interior plies in plywood and in concealed parts of furniture and other products. The principal species employed are red gum, tupelo, yellow poplar, yellow birch, and hard maple. Another important use for hardwood veneer of the lower grades is in containers. The industry producing these hardwood products is widely distributed throughout the Southeast, the Central States, Lake States, and the Northeast.

In the Pacific Northwest the production of Douglas-fir plywood is almost synonymous with the softwood plywood industry. The massive clear Douglas-fir peeler blocks are ideally suited to the production of rotary veneer, as reflected in the rapidity with which this species rose to first place in production statistics, but the industry also has shown that it can adapt its methods to smaller logs as well. Douglas-fir plywood has come to be as well known as the lumber product of this species and is used as paneling, flooring, sheathing, and concrete forms, as well as in hundreds of manufactured products.

Comparing the present veneer-cutting industry which consumes nearly $2^1/_2$ billion board feet of veneer logs annually, with that at the start of the twentieth century, a growth of 12 times is seen.

Only in the case of the western pines, Douglas fir, and other species of the West, does an appreciable part of production now come from old-growth timber. The transition in lumber production from old growth to second growth began in the South which was favored by soil and climate conducive to rapid growth, and it was there that the sustained-yield concept of timber harvesting was first recognized by the lumber industry in the early 1920's. This recognition came too late for most of the big mills, however, and the South has maintained its high-ranking position long beyond the early forecasts of timber exhaustion chiefly as the fortuitous result of natural regeneration following the normal course of liquidation cutting. Because of this situation the transition in the South has brought about a major change in harvesting and manufacturing methods from the large operations and mills of the early manufacturing period to numerous small units. The census of 1947 showed that seven of the eight states having more than 2000 sawmills each were located in the South.

In the Douglas-fir region the transition to sustained yield had its inception in 1933 with the cutting regulations of the National Industrial Recovery Act that provided for leaving cutover lands in good condition for reforestation. By 1935 it was reported that 65 per cent of the logging in that region was being done in compliance with those provisions.

After the Supreme Court decision which nullified the Recovery Act, industry rather generally continued these cutting practices voluntarily. Col. W. B. Greeley has described what took place in these words: "Many influences were at work in the late thirties to make timbermen forestry-minded. One was a revival of faith in their own industry as the depression clouds began to break up. Another was the renewal of the threat of federal forest regulation. Most potent of all was the growing realization that the end of the virgin forests was in sight. In the Far West, cheap stumpage no longer could be picked up in the next valley or county. Timber was more and more strongly held and more closely tied to substantial sawmills, pulp plants, or plywood factories. Speculative holdings and open-market loggers were disappearing from the stage. Second-growth logs were crowding into the mill ponds, and the market for cutover lands was strong. The hoary deities of the market place, Supply and Demand, were taking sides with the growing of trees."

An important difference between the transition in the West and that in the South should be noted. In the West the transition came at an earlier stage in the removal of the old-growth timber. The Douglas-fir region alone still contains nearly 500 billion board feet of old-growth saw timber to sustain a large number, although not all, of its established mills through a prolonged period of transition. No doubt there will be an increased proportion of the cut from small units, but the retention of second-growth lands in the holdings of the larger mills assures a prominent role for the large manufacturing plant. In the Northeast, Lake States, and both northern and southern hardwood-producing areas, the situation more nearly resembles the southern-pine region from the standpoint of the dominance of small production units.

Of utmost importance to the forest industries and to the nation as a whole is the degree to which current growth balances the annual cut. It is evident that the whole future of these industries is dependent upon satisfactory replacement of the timber that is harvested. The total stand of saw timber in the United States, which originally exceeded 5000 billion board feet, is now 1600 billion board feet. Yearly growth, computed on the basis of cubic feet to provide a common measure for the various forms of use of trees down to 5 in. diam, is estimated at 13.4 billion cubic feet. The total annual drain, in the same terms, is 13.7 billion cubic feet—a deficit of only 2 per cent. This near balance of growth and drain is highly encouraging to the establishment of a permanent industry. A further encouraging fact is that the current rate of replacement through growth is more than twice that estimated in 1920.

These statistics do not show the irregularity of surpluses and

deficits by regions or species, nor do they reveal the balance situation with respect to timber of saw-log size. Saw-timber growth is estimated at 35 billion board feet per year, nearly three times the 1920 growth. But total saw-timber drain, including the cut for lumber, veneer, cooperage, pulpwood, and other products, as well as losses by fire, insects, and decay, amounts to 54 billion board feet, leaving 19 billion board feet per year to be taken from capital. This represents an excess of drain over growth of about 50 per cent, a statement that should be examined in the light of earlier surveys of 1920 and 1933 that placed drain of saw timber at five times the rate of growth. The 1945 statistics of the U. S. Forest Service surely reveal a favorable trend when interpreted in terms of the transition through which the forest industry is passing. As more young second-growth stands grow to measurable size and as more non-growing mature-timber stands are harvested and converted into young stands of second growth, the balance will continue to swing toward equilibrium between growth and drain, and the industry will have completed its transition to sustained-yield stability.

THE INDUSTRY TODAY

The most recent survey of all forest-products industries shows that in 1944 the total consumption of timber in the conversion to commodities was 12.2 billion cubic feet.[3] Of this total, lumber accounted for 55 per cent, fuel wood 18 per cent, pulpwood 11 per cent, veneer and plywood 3 per cent, hewed crossties 3 per cent; and lesser amounts were used in the form of posts, round timbers, cooperage, and the numerous other products converted directly from the tree.

The gross value of all timber products in recent years is estimated to exceed 15 billion dollars annually, while that of the products of primary manufacture alone, i.e., lumber, plywood, wood pulp, and so on, is estimated at 4.2 billion dollars. In a 1946 study it was estimated that 3,300,000 persons were productively employed in business directly traceable to the timber resource of the nation. This represents approximately 6 per cent of total national employment in that year. There are about 60,000 sawmills, 650 veneer and plywood plants, and 200 to 250 pulp mills in the United States today. There is an even greater number of secondary manufacturing plants that use the products of primary manufacture. In a survey of wood used in manufacture conducted in 1948, the U. S. Forest Service canvassed 92,000 manufacturing plants that used wood in their product, in the process of making their product, or in making containers in which to ship their product. It seems likely that the total exceeds this number.

Developments in Harvesting. The methods of harvesting timber to supply these vast demands have undergone great changes in recent years. In the small-tree stands of the South and in the East these changes have been brought about largely because of the need for laborsaving devices to sustain production. In the West the stabilization of the industry, with its increased attention to cutting practices that assure continued productivity, required greater flexibility of logging methods than could be provided by the old systems of railroad logging and steam-donkey yarding.

In the Northeast and Lake States timber is relatively small and scattered, and logging operations are generally of small size. The gasoline-powered chain saw is coming into general favor for timber falling. Tree-length logs are now dragged to the roadside by means of the light crawler tractor equipped with winch and sulky. These machines handle loads of 500 to 1500 ft of logs. At the landing, tree-length logs are bucked to saw logs and bolts with chain saws or in semipermanent bucking-up plants equipped with circular saws. Chipping pulpwood at the roadside is undergoing experimental development, but methods of separating bark from wood have not yet been entirely successful. Truck transportation to the mill is almost universal in this region as elsewhere.

In the South too, chain saws have helped to mechanize the falling of timber but the circular wheelbarrow saw is even more widely used. Portable pulpwood harvesters have been introduced for cutting logs to pulp-stick length and the loading of trucks or railroad cars. Transportation of pulpwood also has been facilitated by packaging the wood at the stump by metal straps. Light crawler tractors of 20 to 40 hp are commonly used in conjunction with light wheel-type skidding arches. Chief progress in the handling of saw logs has been the wider use of crawler tractors for skidding and hauling. Such equipment has permitted logging to continue in many areas for the first time on an all-weather basis.

In the Northwest, which has long been noted for the high degree of mechanization practiced in the woods, the power chain saw has now largely replaced hand falling and bucking, the last of the manual logging operations to become obsolete. Except on steep ground, where hand methods are still more practical, power saws have reduced manpower requirements by as much as 60 per cent.

The most important changes in the West are those associated with sustained-yield cutting practices. The clear cutting of large areas, which was accomplished so effectively by the older railroad logging methods with their destructive high-lead cable systems, has virtually disappeared. In the ponderosa-pine region tree-selection cutting is now the rule, and staggered-setting cutting is in almost universal use in the mature timber of the Douglas-fir region.

These changes in cutting practices have led to the use of heavy Diesel-powered crawler tractors equipped with arches for ground skidding, and to truck transportation. The crawler tractor with its bulldozer attachment has made possible the building of economical roads without which extensive truck logging could not have taken place. More efficient use of logging trucks has been obtained by eliminating the delays of loading. Semitrailers that can be loaded at the landing while the truck is en route to the mill and rapidly picked up when the truck returns with its alternate empty trailer are a recent innovation. Preloading in a framework that can be lowered onto a truck is another means of increasing the efficiency of transportation.

Better utilization is being practiced through salvage logging. It was not many years ago that a greater volume of wood was left per acre on the ground after logging in the Pacific Northwest than originally grew on most areas in the rest of the country. Thinning is also yielding small logs of commercial value in many of the older second-growth stands.

Developments in Lumber Manufacturing By far the greater number of the 60,000 sawmills in the United States are of the circular-saw type. Circular-saw mills themselves, however, vary widely in size and type. A small bolter mill may cut as little as 2000 feet per day, while a large circular mill with resaws to cut heavy cants into boards may produce 20,000 fbm per day. Circular saws can handle satisfactorily logs up to about 4 ft diam, which includes all but the larger old-growth logs. Sawmills that cut timber over 30 in. diam are usually equipped with a top saw as well as a main saw. Except for the obvious handicap of removing a $\frac{1}{4}$-in. saw kerf, circular mills do not justify the poor reputation that they have acquired through lax operation. Many circular sawmills have been set up permanently on solid timber or concrete foundations and produce accurately sawed lumber of high quality.

[3] The difference between this amount and the total drain of 13.7 billion cubic feet mentioned previously is due to losses from fire, decay, insects, and so forth.

Because of its relatively light weight, the small circular sawmill is readily adapted to portable operation, and several types of trailer-mounted mills are in use. In the aggregate the production of such mills is considerable, even though individual mills characteristically operate intermittently as the mill is moved from one farmer's wood lot to another.

Most of the smaller circular sawmills produce only rough green lumber, usually round-edged stock. Ordinarily, the operator slabs the log, cuts off a board or two, turns the log flat face down, and completes the sawing without further turning. Sawing in this manner does not yield much quality lumber. The output of such a mill may be sold to a concentration yard where the production of several mills is seasoned, dressed to uniform size, and distributed in carload lots. A rather recent development in the operation of portable mills is to saw around the log for high-quality stock which is then shipped to a larger better-equipped mill for final manufacture to high-grade lumber. The remaining portion of the log is, of course, then sawed at the original mill into lower grades of lumber, usually for local use.

Larger circular mills have edgers and trimmers and often are equipped with dry kilns and planing mills. A number of them have circular or band resaws or are equipped with gang saws. A mechanism known as a "merry-go-round" is a particularly ingenious device sometimes used to feed a resaw of either the horizontal-band or circular type. The cant from the headsaw is carried on a system of conveyers to the resaw, which is adjusted to cut a particular thickness. When the remainder of the cant exceeds this thickness, it is returned automatically to the conveyer and the process repeated.

The log gang saw which is the modern counterpart of Daniel Webster's sash saw is widely used in Europe. With this type of saw an entire log can be converted into boards or heavier stock at one pass of the carriage. It is not possible to cut for grade by this method and its chief utility appears to lie in the mass conversion of low-grade logs to low-priced lumber. This type of saw has not yet come into any extensive use in this country.

The band saw is a most efficient cutting device and is particularly favored from the standpoint of the narrow kerf which is commonly 1/8 in. wide. Consequently, it consumes less power than the circular saw, but this advantage is minor in comparison with the saving of material through reduced kerf. The band mill is a complex mechanism. Its mounting must be relatively heavy and consequently involves a considerably larger capital investment than does a circular mill. Only about 1000 of the 60,000 mills in the country are of this type. Most band sawmills are relatively permanent high-production units. They usually are equipped with a greater number and greater elaboration of facilities for the production of a finished product than is commonly the case with circular mills. Two or more resaws are often used behind the headsaw to increase productivity. Band mills differ considerably in their equipment and layout. Some mills cater to the export and timber trade and require only a minimum of resawing and planing equipment; others cutting in small timber, or in lower grades of large old-growth logs, may aim chiefly at producing green common grades and structural grades of lumber. The most complex lumber-manufacturing operation is that of producing a maximum recovery of clear lumber from large logs.

A West Coast mill of this type having a production of over 600,000 fbm per day on 2-shift operation, is equipped with a single band headsaw with its edger and trimmer, followed by two pony band headsaws, an edger, trimmers, a sash gang saw, several band resaws, re-edgers, and retrimmers. In cutting large high-grade Douglas-fir logs, the head rig first slabs the log, then cuts cants from the outer portion which are further broken down at the gang saw and pony head rigs into clear grades of 1 and 2-in. lumber. Common and structural grades are cut from the balance of the log, and timbers are often cut from the center portion. Resawing permits the upgrading of lumber emerging from the gang or pony headsaws. Nearly 60 per cent of the production of this mill is clear lumber and an additional 8 per cent of shop lumber is obtained.

From the green chain of the sawmill, lumber is carried to the dry kilns and finally to the planing mill. Clear and common grades are surfaced and may be cut to pattern as flooring, ceiling, siding, shiplap, and moldings.

It is of interest that 120 tons of planing-mill refuse accumulate each day from the integrated operation of which this sawmill is but one part. This refuse consisting of sawdust and shavings is used to produce "Pres-to-log" briquettes, while from the sawmill-waste conveyers, another salvage operation collects both wood suitable for conversion to pulp, and bark for a wide variety of special uses.

THE UTILIZATION OF WOOD

Construction. The largest use for lumber is in the field of residential, farm, and industrial construction. Two thirds of current lumber production is used in construction. There are some 40,000,000 residential structures in the United States and about 1,000,000 new units are being built each year. Nearly 90 per cent of these have a lumber framework, three out of four have wood exteriors, and wood is used in the great majority of homes for flooring and interior finish. Nearly 95 per cent of 7,000,000 farm dwellings in the country are built of wood. The construction of new farm buildings, together with the demands for maintenance and repair of old buildings, consumes over 4 billion fbm of lumber each year.

Nonresidential construction, including commercial and industrial buildings, schools, hospitals, churches, utilities, public buildings, and the construction of highways and bridges, consumes even more lumber than the farmer. Each year the Class I railroads of the country use a billion board feet of sawed crossties and bridge ties, virtually all preservative-treated for long life. It is in the field of industrial construction that engineering advances in the use of lumber have been greatest with a resultant increased structural efficiency obtained through improved timber connectors, shear developers, and advances in the fabrication of laminated beams and arches.

While preparing this paper, the author heard in a radio broadcast that the new ocean liner the *United States* had only two items aboard built of wood—the butcher's block and the Steinway piano. It may come as something of a surprise to others who heard this to learn that wood has any uses at all in our modern Navy. The fact is that wood is second only to steel as a structural material used in building and maintaining our nation's naval forces. In the twelve months of 1944, over 2,900,000 tons of wood were required by the Navy, placing this material first in terms of volume and second in tonnage of the materials needed for all types of naval construction both on shore and at sea.

Manufactured products. In 1948 the total amount of wood used in manufactures was 13.7 billion board feet, 89 per cent of which was in the form of lumber, 8 per cent veneer and plywood, and 3 per cent as bolts. Thus the remanufacture of lumber into finished products constitutes the second greatest outlet for the product of the sawmill (exceeded only by construction), and these same remanufacturing industries are also major consumers of veneer and plywood.

It is impossible here to discuss in detail the many ramifications of these secondary wood-using industries which include the producers of agricultural implements, shoe lasts, matches, pallets, patterns, ladders, pencils, shuttles, and woodenware.

A mere listing of a few of these products, however, serves to emphasize their diversity and the multitudinous and essential ways in which wood is a part of our very existence today.

Five major uses of wood in manufacture deserve special mention. They comprise 77 per cent of the total as follows: Containers, 34 per cent; millwork, 16 per cent; furniture, 16 per cent; flooring, 8 per cent; and railroad-car construction and repair, 3 per cent. All other uses in this category make up the balance of 23 per cent, no single item exceeding 2 per cent of the total.

It is in these remanufacturing industries that the important role of the hardwoods is made most clear, for of the total hardwood-lumber production of slightly over $7\frac{1}{2}$ billion board feet in 1948, 6 billion feet were consumed in remanufacture.

Containers. Wood containers include boxes, box shook, baskets, and crates. These products are manufactured for sale by a fairly well-defined group of industries—the wooden box, basket, and millwork industries—and this group consumes about 60 per cent of the total wood used in containers. The remaining 40 per cent consists of wood used in the factories of other manufacturers who make shipping containers for their own products. The 1948 production of containers required about 5 billion board feet of lumber, veneer, and plywood, a total not essentially different from that of 1940, despite the expanding use of fiber boxes. Lumber comprised about 86 per cent of the total, veneer and plywood, the balance. An increase of 4 times in the proportion of veneer used since 1933 reflects the trend toward the wire-bound veneer box.

The years of World War II brought about an amazing expansion in the use of shipping containers for war material and supplies. In 1944 the use of lumber alone for this purpose rose to more than 15 billion board feet, or 44 per cent of total lumber production. For every 10,000-ton cargo vessel that left our shores, one quarter of a million feet of dunnage lumber were required as cargo bracing. Three hundred board feet of lumber were required in the form of containers for the supplies needed to place each of our soldiers in the field overseas, and an additional 50 board feet per month were needed to keep him there. Crating for a single airplane required 5000 board feet.

In peacetime the box and crate do not play so dramatic a role, but they continue to serve year in and year out in assuring safe delivery of the fruits of agriculture and industry.

The leading species used in container lumber are ponderosa pine, southern yellow pine, red gum, and eastern white pine. Of the veneer species, red gum and tupelo constitute over half of the total volume used. The nationwide distribution of the industries engaged in the manufacture of wood containers is indicated by the fact that the nine leading states in production account for only 50 per cent of the total. California tops the list, followed by such industrialized states as Ohio, Michigan, Illinois, and New York.

Millwork. Millwork includes sash, window and door frames, doors, cabinet work, stairwork, molding, and interior trim. In 1948 about $2\frac{1}{4}$ billion board feet of wood were used in millwork, 96 per cent of it in the form of lumber, the balance plywood. The manufacture of millwork involves mass production with a relatively high degree of precision as compared with the production of common lumber. The quantity production of millwork items in specialized factories according to standardized patterns has been largely a development of the past 50 years. Lumber suitable for millwork is selected at the sawmill and graded as factory lumber on the basis of the relatively defect-free cuttings that may be obtained from it. Because of the need for dimensional stability and the accurate fitting of the component parts of many millwork items, factory lumber is carefully kiln-dried and planed in preparation for machining and assembly into finished millwork products.

At the millwork factory the lumber is usually handled from storage in unit packages of 2000 fbm or more with motorized stackers and straddle carriers. It is first reduced to blanks by rough-ripping, cutting, reripping, and jointing. The primary objective in these operations is to recover the maximum quantity of usable blanks from the lumber. Skilled operators having the opportunity to select for a typical wide range of sizes, from window sills to muntins for sash, are able to recover more than 80 per cent of usable cuttings from shop grades of lumber. At least one quarter of the balance usually can be used in by-product work such as core blocks to be glued into door panels. In such cases only the smallest blocks less than 5 in. in length are wasted.

Milling operations include linear and cross milling. The modern molder, used for linear milling is a 4 or 6-spindle machine with a hopper-feed table. These spindles carry 6 or 8 milled-to-pattern cutters and operate at feed speeds up to 150 linear fpm. Most cross milling is done on machines of the double-end tenoner type. Special machines have been developed for specific jobs. The cross-milling machines are equipped typically with interchangeable smooth-cutting saws, slotting saws with side clearance, and milled-to-pattern knives to accommodate the variety of cuts to be made. In both linear- and cross-milling operations, the finished dimensions are held closely to "go" and "no-go" tolerances through the use of metal templates. Milling operations are followed by assembly gluing in the case of a number of millwork products.

Window-frame parts and assembled window sash are commonly given a preservative treatment, and often a stabilizing treatment as well, by immersion in a solution of preservative or water-repellent chemical.

Ponderosa pine contributes over one half of the total lumber used in millwork, a proportion that has increased steadily since 1928. Together with Douglas fir and southern yellow pine, 75 per cent of the total is accounted for. The leading species used in the form of plywood are Douglas fir and red gum. Washington and California are the leading centers for millwork, reflecting the influence of proximity to the source of abundant high-grade softwood lumber. Among the six states contributing to 50 per cent of production, however, are Wisconsin, Iowa, and Illinois. These states acquired their leading position a half century ago in the era of white pine which was renowned as a millwork species, and the stability of their millwork-manufacturing plants provides evidence of the successful operation of wood-manufacturing facilities even though far removed from the source of raw material.

Furniture. Despite the increasing use of metal furniture and some of the striking examples of the use of plastics, glass fiber, and other materials in furniture, over two billion board feet of wood were used in furniture in 1948. This represents an increase over 1928, of more than 50 per cent. Ninety-one per cent of the wood used in furniture is in the form of lumber, most of the balance as veneer and plywood. Four kinds of wood—yellow poplar, red gum, maple, and oak—account for more than half of the lumber used in furniture. Red gum, yellow poplar, and Douglas fir account for considerably more than half of the veneer and plywood employed for this purpose. There have been relatively few changes in the species chiefly employed over the past 20 years. It may be of interest to note that the woods most commonly regarded as cabinet woods—mahogany and black walnut—both as lumber and as veneer—are far down the list, only 37,000,000 fbm of mahogany being used and only 19,000,000 fbm of walnut.

North Carolina leads all other states in the manufacture of wood furniture. In 1948 the plants of that state consumed 17 per cent of all wood used in furniture manufacture, followed by New York, Virginia, California, Indiana, Illinois, and

Tennessee. Together, these states contributed to 50 per cent of total production of wood furniture in terms of the quantity of wood employed for that purpose. In 1948 wood-furniture manufacture was reported from every state of the Union except South Dakota.

Air-dried hardwood lumber, chiefly of the No. 1 common and select grades, is the raw material supplied by the lumber producer to the furniture manufacturer. Such material must be kiln-dried to a suitably low moisture content as the first step in conversion. There is a growing tendency for the furniture manufacturer to purchase hardwood dimension stock which is available in the form of kiln-dried surfaced blanks, or even as semimachined parts. Veneer and plywood are the other forms of wood employed in the production of furniture. These are dried at their source, the veneer or plywood factory, but are reconditioned at the better furniture plants in order to restore the proper moisture content so essential to the successful fabrication of wood furniture.

In the cutting room, lumber is cut to length and ripped on straight-line ripsaws to obtain defect-free cuttings. These pieces are assembled into sets, jointed, and edge-glued to produce blanks for various parts. Recent years have witnessed many notable advances in the use of continuous gluing machines and in the employment of high-frequency electric heating for this purpose. The rough blanks are then face-jointed and sized in a straightening planer that eliminates warp, and finally finished-planed on a cabinet surfacer. The latter machine represents the maximum refinement in precision surfacing generally employed in woodworking.

Veneer is prepared by an analogous procedure involving clipping, jointing, and taping or edge-gluing to obtain sheets of the desired size. The gluing of face and crossband veneers to lumber cores is accomplished in either cold or hot presses. Both solid wood parts and plywood components are subjected to a variety of machining operations before they are ready for assembly. Such operations are carried out on boring machines, dado machines, double-end tenoners, mortisers, molders, routers, lathes, carving machines, and sanders. Some wood components are steam-bent to shape, a process involving steam chambers, bending forms, and drying rooms. Following assembly gluing, in which the use of high-frequency heating is attracting increasing attention, come the finishing operations where modern spray equipment and automatic rubbing machines now prevail.

INTEGRATED UTILIZATION

Throughout the entire country as permanence of the industry is becoming realized, the practice of integrated utilization is taking hold. This represents a great advance over the old-style single-product type of utilization. Ideally, integrated utilization involves the removal of all of the timber that is ripe for harvesting at a particular time, consistent with good forestry practice, and its distribution for utilization to the industry for which it is best adapted economically.

There is probably no better example today of integrated utilization than that practiced in the grouping of plants of which the West Coast band-saw mill described earlier in this paper is a part. That combination of mills includes three sawmills, a planing mill, a briquette plant, a bark-processing plant, a plywood mill, and two pulp mills, one sulphite and one sulphate or kraft. Nevertheless, real progress in this direction is being made in all timber-producing regions of the nation.

In the southern-pine region, saw logs, pulpwood, poles, crossties, piling, and naval stores constitute a logical combination of products obtainable from these versatile species. Hardwoods such as oak, growing on contiguous areas, yield flooring, lumber for manufactures, and distillation products.

In the northern hardwood region, veneer logs are commonly segregated from saw logs and, in at least one operation, veneer-cutting is so closely integrated with the sawmill that logs from which a suitable veneer bolt can be obtained are cross-cut on the log deck of the sawmill, and the high-grade bolt diverted to the adjoining veneer mill. Low-grade logs are utilized for hardwood distillation to obtain charcoal or, more profitably, chipped to provide raw material for chemical pulping or for the production of Asplund fiber for roofing felt, insulation, and other fiber products.

These examples are based largely upon situations wherein single ownerships with large holdings of land and manufacturing facilities are involved. In the not distant past most of the pulp mills in the Northeast were single-mindedly concerned only with cutting to supply adequately their needs for pulpwood. In the course of their operations many hardwoods ideally adapted for veneer cutting were overlooked or, if not too large for their light equipment, bucked to pulpwood lengths and delivered to the pulp mill for chipping. Today such high-priced material is being sold or traded with other operators who are seeking veneer logs. It is anticipated that this example will be followed by a large number of producers throughout the country who are not in a position to diversify their own manufacturing facilities, but who can profit from the better utilization of timber thus made possible.

Gas-Turbine Power Plant

AFTER three years and 23,000 hours of operation of a General Electric gas turbine without service repairs, the Oklahoma Gas and Electric Company has placed a second 4000-kw gas-turbine unit in service at its Belle Isle generating station.

The installation of the original gas-turbine unit three years ago was the first commercial use of a gas turbine for electric-power generation in the United States.

Although the first unit has a rated capacity of 3500 kw, the average load for the three-year period has been over 4400 kw, or more than 120 per cent of its rating.

The second unit, which began commercial operation in July, is essentially a duplicate of the first. Improvements in design and manufacture have made possible the rated capacity of 4000 kw. It is expected that under favorable conditions, the new machine will deliver up to 5000 kw.

The two gas-turbine units and two larger steam-turbine generators in the Belle Isle powerhouse use natural gas as fuel. The exhaust of the two gas turbines is used to heat boiler feedwater for steam units whose total rated capacity is 50,000 kw.

With the two gas turbines in operation, maximum output of the steam units has been increased from the former capability to a gross output of 65,000 kw. The two gas turbines are credited with 9500 kw of this output.

The G-E turbines contribute not only their own 9500 kw, but boost the output of the steam units by 4500 kw, or nearly 10 per cent, by heating boiler feedwater used in the station.

It was pointed out that in the case of steam turbines, natural gas is used to heat water and make steam at high pressure and temperature which is directed through nozzles to turn up the turbine connected to a generator.

With the gas turbines, natural gas is used to heat air to a temperature of 1400 F. The hot air is then expanded through turbines to develop power for turning the generators.

Remaining heat, which would otherwise be wasted after turning the turbines, is used to heat boiler feedwater for the steam units, increasing their efficiency.

ENGINEERING *and* POLITICS

The Roy V. Wright Lecture at the Centennial of Engineering

By RALPH E. FLANDERS, U. S. SENATE

NOT many weeks ago I was driving with a car full of grandchildren under a high railroad bridge in the adjoining State of New Hampshire, and there came to my mind the story of the designer and builder of that bridge. I told my grandchildren about him. He was a certain Major Whistler. He was a West Point graduate and, as I remember, a teacher at West Point. There he had studied engineering and was versed in what I suppose we must call military engineering. But he left the Academy, went into private practice, and it was as a civil engineer that he built for the old Sullivan County Railroad in the late 1840's this high bridge over the Sugar River.

Major Whistler's services here antedated the formation of the American Society of Civil Engineers. He went from his private practice in this country to Russia and built for the then Czar the railroad line between St. Petersburg and Moscow.

I do not suppose that we would today remember this military engineer, become civil engineer, were it not for the fact that Major and Mrs. Whistler had a son. He was born in this country but spent his early life in Russia while his father was chief engineer to the Czar. He later returned, studied art in Paris, and became the great painter whose "Whistler's Mother" is known to every school child.

Major Whistler marked the transition from military engineering to civil engineering in this country, and shortly after he ended his practice here, the American Society of Civil Engineers was established in the United States. This was in 1852. The British had already marked the division by the establishment of their Institution of Civil Engineers in 1828. Since that time both in England and America a number of specialized branches of engineering have separated from the parent organization, even as children leave the old homestead when they come of age. Our mechanical, electrical, and mining engineering branches still remain closely connected as members of the Founder Societies. However, we recognize the civil engineers as being our parents and we rejoice that we have had the opportunity to visit with them and take part in the ceremonies of their centennial celebration.

ENGINEERING HAS AFFECTED OUR POLITICAL PROBLEMS

The changes brought about by engineering are so well known to us that they have become trite and commonplace. Our familiarity with them tends to make us take pretty much for granted the enormous changes which they have brought about. It is sufficient to say that they have reduced the size of the world to a thousandth of what it was two centuries ago when size is measured in the speed of circumnavigatory travel. There are no longer any unknown or remote regions. The simple political and economic problems of a century ago have been intensified, magnified, and rendered all but insoluble by their very complexity. This is what engineering has done in the one field of communication and transportation.

In the field of production it has enabled a few hours' work to give us what would have required weeks of application one hundred fifty years ago. It likewise gives us in return for a few hours and a few days or weeks of work articles which were not in existence a hundred years ago and which would have no existence today were it not for the art of engineering working on the materials furnished by science. The electric refrigerator, the television set, the automobile, and the airplane are obvious examples.

Engineering has likewise produced a dependence of everyone on everybody else for keeping our industrial society going. This is perhaps its most important and most dangerous characteristic in our society. We can form a mental picture of its importance by a rapid review of the social and economic conditions in this country since the white settlers first landed and established homes on this side of the Atlantic.

When the English settlers first arrived, we may suppose that what now constitutes the New England States, to take that area as an example, supported an Indian population numbered in tens of thousands at the most. The food supply was far from abundant. Some fishing was done, both in the ocean and in lakes and streams; primitive agriculture was practiced, directed mostly to the raising of Indian corn. The main dependence was upon hunting, which provided food, clothing, and shelter. In an economy of this sort only a sparse population could be maintained in a standard of living that was both low and strenuous, though it was in its essentials honorable and honest.

The English brought tools along with them. Most importantly they brought plows, harrows, hoes, rakes, and shovels. By real cultivation they enormously increased the food which could be obtained from a given area.

Besides agricultural implements, they brought the technical knowledge which went into the making of spinning wheels and looms. They brought the sheep and they raised the flax. They brought the knowledge of the water wheel and sawmill. These and their carpenter's tools provided them with housing which gave them the warmth and shelter wherein the yarn was spun and the cloth was woven during the short winter days and long winter evenings.

With these few primitive tools, the settlers on the rough New England Coast were enabled to live in a comfort which the Indians could not have imagined. The territory which could only support tens of thousands now supported hundreds of thousands on an agricultural and home-industry basis.

But this progress did not stop. The trades and handicrafts flourished. There were tanners and shoemakers. The wool processes were not all performed at home. Fulling mills and dyers began to take over part of home industry. The candlemaker, the ropemaker, the printer hung out their signs. Industrial life became more fragmented, more skillful, more efficient, and more complicated.

Then came the beginning of the machine age when the whole textile industry was transferred to factories, and thousands of men and women left the home shelter to make with greater ease and an enormously increased efficiency the textiles which had formerly been made at home. Pretty nearly everything else except the food prepared and cooked at home followed the textiles. Many of the things for family use, as in my own youth, were made by village industries, but they in turn faded out of the picture until everything except the home-

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cooked food was made outside the home, perhaps hundreds or even thousands of miles away, was sold in stores and bought for the family by the breadwinner out of the sale of the agricultural products he had raised or from the wages which he had earned in his fragmentary part of an industrial civilization.

This has now become a complete interdependence. Everyone of us is helpless without the assistance of all the rest of us. We cannot live without each other. A failure of any particular group to perform its functions brings hardship, distress, and even danger to the other groups of the industrial community.

The quantitative result of all this has been that in the New England area, which I took for my example, nearly thirteen million people live in that area whose inhabitants at the most were tens of thousands of Indians. Both they and we live in insecurity. Their insecurity resulted from natural variations in game and fish supply, from crop abundance or crop failure, and from the necessity to protect their hunting grounds by force against hostile tribes. Our insecurity is built into our industrial structure wherein the tremendous engineering advances of the recent generations have made it necessary that everyone play his part in supporting the whole. The free American is no longer free economically. He is bound to all his fellows, through the requirements of life in a society which engineering has constructed for us. The material benefits of living in this society are enormous. The dangers are those of a total breakdown through lack of co-operation. This total breakdown could conceivably mean suffering and death for the millions of people whose very existence depends on the maintenance of our engineering manner of living.

We are accustomed to sum this all up by saying that science and engineering have brought to the world problems at least as great as the problems they have solved. It is suggested that these inventions and developments have come faster than we can assimilate them. There have even been proposals made for setting up a moratorium on science and engineering while we catch up with the social problems involved in digesting the changes already made.

Of course, no such moratorium is possible. The human mind of creative man works almost without his consent or without his control. He is its creature, not its creator.

ENGINEERING APPROACH TO SOCIAL PROBLEMS

Another and seemingly more practical suggestion has been that the engineer apply his experience and abilities to the solving of the social problems which his work has created. The assumption is that the social problems have enough similarity to the physical ones to give a reasonable hope that success may be had in the social field similar to that which has been reached in the physical one. To examine this idea briefly is one of the objectives of this paper.

The strict engineering approach to the social field requires that men should be treated as materials are treated. Fundamentally this seemed to be the approach of that group of engineers who called themselves "Technocrats" in the 30's. Now to a certain extent this approach is a proper one. It is essential that we learn how people act under certain conditions. While of the millions of people whose actions are being analyzed statistically, each may determine the solution to his own problems and his own decisions differently; yet, taking the millions as a whole, certain patterns emerge which can be relied on to a very important extent. Here, statistical analysis is in a sense the equivalent of mathematical, physical, and chemical analysis of materials, movements, and forces in the engineering field. We cannot proceed with the preserving of a stable and productive society without making these analyses. They are useful. They are more than that; they are essential. Yet since we are dealing with people and not materials, we have to recognize that in all places and under all conditions the statistical analyses may not remain valid.

For instance, the economic textbooks written a generation ago were based on certain assumptions as to prices, wages, production, and industrial expansion and contraction. Those assumptions could be supported largely by statistical analysis.

But in the last generation we have two new factors in the picture. One is the different behavior of prices under the administration of business units of great magnitude and the other is the reactions between wages and production under the administration of powerful and nationwide labor unions. These two new factors have practically destroyed the old economics.

These are slow changes which invalidate the old structure of social organization. But there are likewise sudden, violent, mass emotional movements which have to be reckoned with. We are seeing them in action today in Iran and in Egypt. They may break out almost anywhere. Now these things make the strictly engineering approach to social organization difficult indeed. In fact they make it practically impossible.

Yet that does not limit the desire to apply cold management to human affairs, for is it not possible to control organization and generate purposeful mass emotion? The answer to this question is of course that it is possible, at least for a period of time. This treating of men like materials and organizing them in somewhat the same way that the engineer builds his machines and his structures was practiced by Hitler and Mussolini. For years they were successful. But the structures they erected were not static structures. They were dynamic mechanisms whose loads and strains and stresses finally broke the bounds of analysis and control and wrecked themselves against the counterbalancing forces of a society which believed that men should preserve their freedoms, instead of submitting themselves to be treated like inert materials.

Yet one of these societies remains today apparently in full strength and apparently with a disturbing ability to expand its organization and its operations. For the Soviet Government is essentially a third undertaking in our time to treat men as inert matter, to control their emotions, and through the control of their emotions and the detailed control of their acts and activities to organize them for the benefit of the organizers. The treatment of men as things is still with us. The social and political organization which does this is the great enemy of mankind.

WHAT WE MEAN BY "POLITICS"

The announced subject of this talk is "Engineering and Politics." Let us next define politics as it is used in this talk.

It is of course quite evident that at this meeting we are not interested in political parties and the normal procedures by which politicians seek to bring success to the party to which they belong. We are thinking of politics in a more fundamental sense. The word is derived from the Greek word "polis" which means city. In Greece the city was the political, social, and economic unit. With us it is the nation. Politics for the Greeks was the organization and well-being of cities. For us it is the organization and well-being of our country. We have to find out what there is in engineering that can lead to our well-being.

We have seen that engineering has resulted in posing to us certain serious problems. We saw, first, that it had squeezed the world together by instantaneous communication and high-speed transportation. What happens in Tibet is of importance to Chicago, even though Chicago at the moment may be

serenely oblivious to the fact. The dangers from this intimacy between us and the far corners of the globe are more than the dangers of armed conquest. They are the dangers among others of the infiltration of subhuman ideas. They are the more material dangers of effects on our economy and the physical well-being of our people.

We have also seen that an industrial society based on engineering makes possible a population greater by more than a thousandfold in a given area than can be supported by a non-engineering society. Yet at the same time we have seen that this society is unstable. It depends on such a measure of co-operation as would have seemed impossible of attainment a century ago. We are seeing that co-operation threatened, yet not destroyed. We are concerned that it be not destroyed but be expanded, strengthened, and made more permanent.

Engineering, then, makes problems. What contribution can it make toward their solution?

I feel that there is an engineering approach to these problems. The engineer has an objective. He studies and analyzes the materials with which he has to deal. He acquaints himself with the natural forces which he cannot change, which are more powerful than he is but to which he can adapt himself so that he may make use of them.

The proper objective of our politics is not world power. It is not power for its own sake, in a national area or in a larger scale as was the case with the Nazi and Fascist regimes. Our objective is the well-being of the people of the United States. This well-being includes material well-being, but it goes beyond that. It includes the attainment of the higher satisfactions of working successfully with each other and of having available to everyone the highest resources of the treasures of the past and the hopes of the future. This national well-being cannot be attained for ourselves alone, for we are too closely tied to the rest of the world. But neither can it be attained by dropping ourselves to the average level to be found the world over. The objective we seek is not a universal level but such an increase in co-operation and production, material and spiritual, as will form a background for our own development.

The materials with which we have to work are the people of our country and the people of the world. To some extent these materials can be studied objectively. They can be analyzed statistically. They can be observed and considered in nonmathematical ways by sympathetic and interested students.

The forces on which we have to reckon are the least understood and the least applied of all the factors in this engineering approach to human welfare. Those forces are finally to be found in the spiritual realm. They are the powers which govern their destinies. The most concise statement of them is to be found in the words of Jesus when he said, "Thou shall love the Lord thy God with all thy heart, and with all thy soul, and with all thy mind. This is the first and great commandment. And the second is like unto it, thou shalt love thy neighbor as thyself."

PROPOSALS FOR PEACE IN KOREA

All this is vague and general, though fundamental. In talking with engineers such vagueness and generality, however fundamental, will not arouse particular interest.

I propose such a specific objective, the task of ending the war in Korea. With that as an example let us examine the materials and see what can be done toward applying the forces.

As for the people we are immediately concerned with—the Chinese Communists, the people of North Korea, and the people of South Korea. Taking first the Chinese Communists, they have expressed no other interest or purpose in this war than the safeguarding of the border of Manchuria against invasion. Could some guarantee be given them against this danger, they could not proceed with the war without stultifying themselves and they could cease the conflict without losing face, which is an important consideration with Oriental peoples.

The proposals made to Communist China would be the neutrality of the Yalu Watershed in Northwest Korea. This territory is sparsely populated, and valuable primarily as a supply of hydroelectric power to Manchurian industry. We would propose that its military neutrality be inspected and administered by a commission from completely Asiatic peoples. Pakistan, India, Ceylon, the Philippines could engage in this undertaking of Asia for the Asiatics. No white peoples, no capitalistic nation, no colonizing empires would be permitted on this commission. This has in it elements of appeal to the Communist Chinese Government and would strike new respect throughout Asia of usefulness and confidence in United Nations procedure and particularly in the position of Asia as to the United States. It would mean a revolution in Asiatic thought toward us and a revolution is long overdue.

We would rain peace offers on the armies of Communist China and on the people of North Korea. We would assure the armies of the Communist Chinese that all the interests of their government would be protected. We would urge them to cease combat and retire. We would do this the more confidently, since we know that 100,000 of the 170,000 war prisoners do not wish to be returned. They have lost sympathy with the plans and the policies which sent them into this bloody conflict.

On the people of North Korea we would rain from the air peace offers of rebuilding industry, transportation, and housing. We could well afford to do this if the people were in a mood to surrender. It is costing us around six billion dollars a year to carry on this war. Six billion dollars in reconstruction would go a long way.

We would offer this reconstruction to a united North and South Korea. The inhabitants of neither section can enjoy a prosperous peace separated. The industrial north and the agricultural south must be brought together. When brought together they can enjoy as a practically self-contained economy a standard of living that is higher than is available to any considerable area anywhere else in the whole continent of Asia.

The Chinese Communist Government, the Chinese Communist armies, the people of North Korea, and the people of South Korea all have a stake in a peace proposal of this sort.

In making a proposal of this kind, we have behind us the spiritual forces of the universe. We are not trying to use these people as tools for our own interest. We are in a real and effective sense loving our Korean neighbors as ourselves.

And yet as I suggested earlier, this serves our self-interest as well. It is to our interest that the peoples of Korea should be protected from invasion. It is to our interest that they should be free, productive, and enjoying the material, political, and spiritual benefits which reunion and reconstruction can bring to them. By treating them with love as our neighbors, we benefit ourselves as well.

This engineering approach to one of our larger problems sets up a human objective, makes use for their own benefit of human materials, and employs the spiritual forces of the universe.

All of this points the way to a new diplomacy which shall not be based on power for its own sake, which shall not be primarily concerned with the dealings of governments with governments. The new diplomacy will act between governments and peoples and between peoples and peoples. In this new approach based on the analogy of engineering we have the way out of this "time of troubles" which otherwise is endless and insoluble.

ANATOMY *of* ENGINEERING

From an Engineering Freshman's Point of View

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IN view of the shortage of engineers demonstrated so forcibly by the present unfulfilled demand for engineering graduates, it might be well to ascertain and examine some of the various reasons why freshmen college students enroll in engineering colleges, in order to determine the types of individuals these freshmen are and to explore their concepts of the engineering profession. A successful evaluation of these factors may lead to the formulation of an educational program which will attract superior high-school graduates to the profession.

If the influence of the draft is excluded, two questions may well be asked: Why are the young high-school graduates failing to enter the engineering college as freshmen students? Are the colleges attracting the best type of high-school graduate, or is not only the number but the quality of entering engineering freshmen decreasing?

As a partial attempt to answer these as well as many other related questions, a survey was conducted over a period of five semesters—from the spring semester, 1946, through the spring semester, 1948—among the freshmen students enrolled in a required introductory engineering course. A total of 622 students was included in the survey.

REASONS FOR STUDYING ENGINEERING

The first question in the survey dealt with the reasons for entering the engineering college. Table 1 lists the replies in percentages.

TABLE 1 REASONS GIVEN FOR ENTERING AN ENGINEERING COLLEGE

Reason	No. of replies	Per cent of replies
To improve my social position over that of my parents	9	1.4
To get a good general education	114	18.4
To study engineering	498	80.0
My parents wanted me to go into engineering	1	0.2
Totals	622	100.0

These results indicate that four out of five engineering freshmen begin college for the specific purpose of studying engineering. It is, however, rather interesting to note that roughly one out of five enters to obtain a good general education.

The second question was designed to aid in an attempt to isolate some of the reasons for the student's selection of engineering as his field of study (Table 2).

As the table shows, answers to the first question revealed that 18 per cent of the engineering freshmen entered engineering college to obtain a good general education. Similarly, answers to the second question indicate that approximately 15 per cent of the entering freshmen believe that engineering is a useful training for other professions. These answers, therefore, appear to be consistent and reveal that a fair percentage of freshmen elect to study engineering even though they expect to enter other professions.

TABLE 2 REASONS FOR SELECTING ENGINEERING AS A FIELD OF STUDY

Reason	No. of replies	Per cent of replies
It is a man's occupation	1	0.2
I enjoy making things	73	11.7
I am interested in the application of scientific principles	383	53.6
Engineering proves good training for other professions	92	14.7
A high-school counselor advised me to	2	0.3
I do not know why	3	0.5
I want to be my own boss	10	1.6
I like outdoor work	24	3.9
I was good in high-school mathematics	16	2.6
I am interested in scientific research	68	10.9
Totals	622	100.0

As might be expected, more than one half of the students checked the answer to the third question which concerned the application of scientific principles. While at first this question might be considered a leading one, the answer is confirmed by a survey of graduates of the classes of 1947, 1948, 1949, and 1950.[3]

Analyses of answers to other questions contained in this survey reveal some interesting trends. For example, approximately 11 per cent of the students indicated that they would not continue college if they could find a good job which paid a salary of approximately $250 per month. This percentage is not excessive. An examination of the answers to questions 1 and 2 show several reasons for studying engineering, which, when good jobs are plentiful, may not be sufficiently magnetic to keep a student in school.

It is perhaps somewhat surprising that 43 per cent of the students have relatives who are engineers. Fifteen per cent of these students have fathers who are engineers and 12 per cent have two or more relatives who are in this profession. This factor alone may play a greater part in the reasons why students take up engineering than has been realized in the past.

In answer to the question, "If it were not possible to study engineering, what would you do?"—only 6 per cent indicated that they would leave the university. The remainder would major in some other field, 50 per cent indicating that this field would be physics or chemistry. From this, one might conclude that the study of engineering for its own sake is not the motivating force which brings the student to college nor the one which holds him there.

AS THE FRESHMAN SEES IT

Let us next examine the engineering profession through the eyes of the neophyte freshman. The survey reveals that ap-

[1] Lecturer in Engineering. Mem. ASME.

[2] Associate Professor of Engineering.

Contributed by the Education Committee of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[3] "An Analytical Study of Engineering Graduates," by H. W. Case and W. P. Wallace; paper presented before Southwest Section Meeting of the American Society for Engineering Education, University of Southern California, December, 1950.

proximately 20 per cent of the students believe that the average engineer spends the majority of his time out-of-doors; 35 per cent believe that his time is spent in an office; and 45 per cent believe that the drafting table is where he labors. The freshmen also believe that about one third of the professional engineers spend their time developing processes and machines; about 10 per cent do calculating; another 10 per cent prepare drawings, and the rest do such jobs as managing personnel, selling, and so forth.

The type of work that the freshmen believe engineers do is rated in the following order, the most common types being: Production, development, operation, and design—while research, sales management, and teaching are believed to be the least common. However, the type of work which is listed as preferred by these "student engineers" themselves is rated in the following descending order: Design, development, research, production, operation, management, and sales. Hence we have the situation shown in Table 3.

TABLE 3 HOW FRESHMEN VIEW THE ENGINEERING FIELD

Work which freshmen engineering students believe engineers perform (Listed in descending order)	Work freshmen engineering students prefer to do upon graduation (Listed in descending order)
1 Production	1 Design
2 Development	2 Development
3 Operation	3 Research
4 Design	4 Production
5 Research	5 Operation
6 Sales	6 Management
7 Management	7 Sales
8 Teaching	8 Teaching

BELIEFS AND MISCONCEPTIONS OF THE FRESHMAN

These freshmen believe that to guarantee success in their chosen field the two principal prerequisites are (1) interest and willingness to learn, and (2) a pleasant personality.

Who is qualified to be a professional engineer? One third of the students believed that it is necessary to have a license; one third, that it is necessary to do work of an engineering nature. The remainder of the answers were almost equally distributed among such requisites as membership in an engineering society, college degree, and a title granted by the employer.

One question was composed of several statements concerning the engineering profession itself. The students were asked to check these statements as true or false.

Some of the more revealing confusions of concept can be seen in the following:

1 More than half the students felt that a background in engineering economics was not important for engineers.

2 About one quarter of the students felt that it was not necessary to start at the "bottom of the ladder", in industry if one had a college degree.

3 Three quarters of the students felt that the field of agricultural engineering was not clearly defined.

4 Thirty per cent of the students felt that the field of sales engineering was not clear to them.

5 Forty per cent of the students stated that the term "Hydraulic Engineer" was not clear to them.

In answering a question regarding the type of work they anticipated doing upon graduation, the majority of the students expressed fairly definite ideas (although in most cases the jobs described were in very broad classifications, such as research, mechanical, civil, electrical engineering, and so forth.) Only 1 per cent of the total indicated teaching as an outlet for engineering students. On the other hand, some students were very specific in their answers, listing such activities as small-boat design, atomic engineering, drafting, foundry work, stress analysis, and so on.

The high-school subjects which the freshmen believed to be the most important bases of an engineering profession were mathematics, physics, and chemistry—with English and mechanical drawing a poor fourth and fifth in importance. The least important subjects appeared to the freshmen to be civics and history, music and art, foreign languages, English and literature, biology, and physical education.

Some important and related facts compiled from these students reveal that approximately 75 per cent of them had to earn part of their expenses while in college, and 10 per cent had to earn all of their expenses. Only 15 per cent did not need to work while in school. Therefore, these freshmen were in general a working class.

As indicated previously, 43 per cent of these students had relatives who were engineers; therefore, the student may have had some previous knowledge of the engineering profession. This was confirmed to some extent by the fact that three quarters of these neophytes had a definite type of engineering job in mind for postgraduation.

Surprisingly enough a total of 71 students (or 11 per cent) stated that they had no hobbies of any kind.

Over 50 per cent wished to specialize in a broad branch of engineering, such as mechanical, electrical, and so on. Approximately one third wished a well-rounded and general education in engineering. The remainder wished to specialize in a limited branch.

TABLE 4 TYPES OF INDUSTRIAL EMPLOYMENT

Most preferred, per cent	Type	Least preferred, per cent
35	Small private firm	16
28	Large corporation	34
29	Work for yourself	16
8	Government service	34

The indicated preference for type of most and least preferred industrial employment is given in Table 4.

CONCLUSION

It may be concluded from this survey that the engineering profession is not clearly understood by the freshman engineering student. The problem undoubtedly can be solved through the suggestion by the Engineering Manpower Commission of the Engineers' Joint Council that the university and the engineering profession jointly should penetrate the high schools to acquaint the students more intimately with information and data concerning the engineering branches.

Should these steps not be taken and the student find himself enrolled in an engineering college without prior guidance, general guidance and orientation courses related to the field should prove of assistance.

ACKNOWLEDGMENT

The questionnaire was designed by Samuel N. LeCount, Director of Adult Education, College of Marin, Kentfield, Cal., in consultation with E. D. Howe, Associate Dean, College of Engineering, Berkeley Campus, and L. M. K. Boelter, Dean, College of Engineering, Los Angeles Campus, University of California. It was administered to approximately 80 freshman students on the Berkeley Campus by Baldwin M. Woods and to 542 freshman students on the Los Angeles Campus by H. W. Case.

Particularly, we wish to express our appreciation to L. M. K. Boelter for his kind criticisms of this paper.

CAN ENGINEERING GRADUATES MAN *a* COMPANY?

By E. G. BAILEY

CHAIRMAN OF THE BOARD, BAILEY METER COMPANY. PAST PRESIDENT ASME

MY answer to the question, "Can engineering graduates man a company?" is yes, because they are now doing it very creditably in many cases. The important point is: How can each one of us study the many cases at hand and draw some helpful conclusions regarding college curricula, selection of graduates, training, and promotion of engineers for the best interests of our industrial economy?

The success of a company is usually measured by its usefulness to mankind, its rate of growth, and its earnings. A good record in these respects is usually the result of teamwork on the part of management to evaluate properly the needs in a given field of products or services, and to accomplish results through invention, development, production methods, sales, services, and finance.

The August 30 issue of *Business Week* gives some interesting data regarding ten companies which show a marked contrast to the average of industry generally over the same period. Eight of these ten companies show an average increase in invested capital of 42 per cent per year from 1929 to 1951, while the invested capital of industry generally increased at the rate of 2.8 per cent per year over the same period.

The net profits of the eight companies averaged 11.2 per cent of invested capital in 1929 and 9.6 per cent of the increased capital of 1951. It would be interesting to study the management policies of these companies with respect to our topic.

Statistics alone are sometimes misleading. During a depression the earnings and growth may be poor even though the management is good. Contrariwise, during an inflationary "easy prosperity" like the present, very poor management of a company may not be evident even to the stockholder.

Now, let us review some average statistical data from the Engineers Joint Council survey of 1946 on "Employer Practice Regarding Engineering Graduates."[1] In this summary 125 companies, with a total of 2,020,000 total employees, reported 38,000 engineers employed. This is 1.8 per cent of the total number of employees, or one engineer for each 55 employees. In some industries the engineers were 6 per cent of all employees and in others as low as 0.3 per cent. In some groups the engineer executives comprised 50 per cent of all executives of the same rank, and in others as low as 13 per cent with an average of 28 per cent. The anticipated increased need of engineers was 6 per cent per year of the engineers then employed, or one engineer for each 1000 employees.

From this survey a median of the 14 companies within the machinery group has been selected to represent a typically average industrial company. This we shall call "X-Machine Company," employing a total of 7000 people and having a gross sales of about $80,000,000 per year. This is a fairly representative figure of about $12,000 output per employee.

This company employs 133 engineers, 28 of whom, which is 21 per cent, are in executive and top management positions. The total number of executives and upper managers is 64, of whom 44 per cent are engineers.

This industry group said they needed 8 per cent additional engineers per year, or, for "X-Machine Company," 11 engineering graduates each year, or 1½ engineers per 1000 employees.

In my opinion, a company in this kind of engineering business should have about 80 per cent of its executives with engineering training. The reason for this is that an engineering education is eminently helpful as a background for factual approach to the problems encountered in industry, based upon engineering processes, products, and services. Many companies do not now have this high percentage of engineering graduates but they should gradually build up to a higher and more adequate proportion.

Whether a company is increasing its proportion of engineers or continuing on a normal basis, it should employ a certain number of new graduates each year. I mean each and every year whether business is good or bad. One of the mistakes which many companies make is to take on fewer graduates when times are a little slack. This leaves a gap in the supply of properly trained men a few years later when they will need more men than they will then have. For instance, we all short-changed the engineering graduates during the depression of the thirties, and subsequently we needed them badly during World War II. In 1949 all of the available engineering graduates were not given proper jobs and, as a result, a shortage is being experienced today.

Hiring the proper quota of new graduates is not enough. They should be enrolled in proper training courses and given every opportunity to learn the business and develop into positions of responsibility and leadership. To help industry do a better job in such training is the purpose of A. C. Monteith's activities in ECPD during the past few years.[2]

I will not go into detail regarding the training course itself but I would like to express some opinions about the problems of the later advancement of these trained engineers through the upper echelons of the company.

Engineering graduates, while they have received the correct basic engineering training, are human beings with differences in temperaments and abilities in both technical and administrative fields. To successfully man a company with engineers requires considerable development of the men over and above what they are when they receive their diplomas.

The usual organization chart is drawn to show the line of authority running down from the top. It should also be looked upon as the path for advancement from the bottom upward toward the top position of president.

Upon completion of the training course, the engineer is usually assigned to a department in a particular division and then, for a time at least, left to the mercy of whoever happens to be his immediate boss.

I think the education department should have a continuing

[1] MECHANICAL ENGINEERING, January, 1948.

Delivered at a luncheon in Chicago, Ill., Sept. 6, 1952, at the Twentieth Annual Meeting of the Engineers' Council for Professional Development.

[2] Mr. Bailey refers here to the training program, "The First Five Years of Professional Development," proposed by the ECPD Training Committee, of which Mr. Monteith was chairman.—EDITOR.

interest with some co-operative authority to make sure that the individual is treated fairly with reasonable assurance that his advancement will be the greatest of which he is capable.

At some point in this upward progress, each man should become known personally to the top management so that he will be properly evaluated and given every possible chance for deserved promotion in so far as justified by relative competitive abilities.

Now a word about engineers for top jobs in comparison with men trained in the legal, financial, or "business administration" fields.

The top executives should form a strong team, proficient in finance, sales, production, and especially in engineering, research and development, and invention. Each and every one should know the product in every detail, and especially from the customers' viewpoint.

The customer is all-important and a full knowledge of his needs and future trends should be known not only by the sales department but also by the production and engineering departments, and especially by the president. As the products and services of industry are largely within the engineering field, it is best that all members of this management team should be engineers or men with an engineering background who have advanced on their own initiative into fields of finance, sales, and management.

Some lawyers and bankers have become very engineering-minded and have used good judgment in making major decisions regarding engineering, research, and development problems when they have confidence in and give opportunities to the engineers in the team to analyze and evaluate the problems properly.

The degree of success of a company rests almost solely with the president or top executive officer. It is he who selects the vice-presidents and top staff and establishes the policies and methods for co-ordinating the different divisions and departments.

Many of the most successful companies, large, small, and intermediate in size, have done very well in the training and advancement of engineering graduates throughout their organizations up to and including the presidency.

Those that have not done so well in this respect simply do not grow and prosper. They either limp along, or fail, or are absorbed by others. When a successful company makes some changes that are not for the best, it may be several years before the mistakes are fully realized, because a going concern can drift for some time upon the reputation and momentum of the past.

Many of us can relate cases where improvements should be made, but it is best to study factual data of successful companies for the benefit of all. The engineering profession should present to the top executives of American industry illustrative factual data relating to the successful use of engineers in such an effective manner that all will strive to improve their present methods for selecting, training, and advancing engineering graduates within their respective companies.

ASME COUNCIL MEETS DURING 1952 ANNUAL MEETING
(December 1, 1952.)

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. JAKLITSCH, JR., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources, and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Youth and Engineering

A GOOD insight into this nation's newly elected President's thoughts on the importance of engineering and the contribution to technical progress by the nation's youth is contained in a statement made to the American Society for Engineering Education on "Youth and Engineering," by President-Elect Dwight D. Eisenhower, from which the following paragraphs are quoted:

"The United States is facing critical times, and in the coming years we must make the best use of the vigor, enthusiasm, intelligence, and technological skill of young people of this country.

"It is true that Americans of an older generation may fix the line and set the goals for conduct of our affairs, but it is just as true that we must depend upon youth to provide the sinews that will carry us toward those goals.

"In this regard, our educational system has a greater and more pressing responsibility than ever before. It can encourage diligent awareness. It can arm us with the knowledge we need to protect our freedom and our economic well-being. Schools must fit our young people for the crises of our times or the freedom and opportunities of the schools will disappear in the ruin of all our free institutions. To this end, academic freedom must be encouraged, and that means nothing more than specific application of the freedoms inherent in our way of life.

"Far too many young people suffer deprivations as a result of inflation, high taxes, and maladministration of our affairs. We must re-examine our economic and social policies. In education we must remove hindrances to the exercise of parental responsibilities, and we must strengthen the effectiveness of community action where it is necessary to supplement home influence in the rearing of our youth.

"The value of engineering and engineering education in securing this peaceful world cannot be overemphasized. The engineer has made many contributions in developing our national economy and our military preparedness program. In our highly complex technological society, the engineer is the creator of our modern tools of production. His efforts are largely responsible for America's great productive capacity and industrial superiority.

"During the past World War, I saw engineers and scientists create instruments of warfare which gave our troops overwhelming military and strategic advantages. Their tremendous accomplishments in carrying on the research, design, and production of such equipment as radar, the proximity fuse, the atomic bomb, and submarine detection, as well as developing superiority in airplanes, tanks, guns, and ships hastened the conclusion of the war and saved thousands of American lives.

"Creative ability is one of America's greatest assets—one which we cannot afford to waste. Engineers, already in short supply, must make their contribution to the nation's welfare at their highest capacities where their special training can continue to accomplish miracles of production—our principal weapon in defending our society of free men."

General Eisenhower's complete statement appears in the November, 1952, issue of *The Journal of Engineering Education*.

Key-Commodities Outlook

A LONG-RANGE survey from 1950 to 1975, of United States and free-world prospects for 30 key commodities, such as metallic and nometallic minerals, rubber, and chemicals, including basic projections of demand, estimates of reserves and potential resources, and statistical measures of raw-materials production and consumption, is given in volume II, "The Outlook for Key Commodities," of the President's Materials Policy Commission.

FERROUS METALS

Iron and Steel. Prospective supplies of iron and steel material for the United States are such that market processes (supplemented by tax incentives) can be relied upon to satisfy normal needs. The industry is actively developing new sources of ore, building new capacity under the stimulus of accelerated amortization, and experimenting with new technology.

Iron is among the most abundant of metals, constituting nearly 5 per cent of the earth's crust. In the form of foundry and steel-mill products, it provides four fifths of the metal consumed in the United States.

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at the usual rate, 40 cents per page.

During the present century the iron and steel industry in the United States has shown marked growth. Output increased by 350 per cent from 1900 to 1925, and by almost another 100 per cent from 1925 to 1950. Estimates of possible domestic requirements for iron and steel, based upon projections in the end uses of various iron and steel products, indicate a possible demand for 140 million tons of steel ingots and 25 million tons of iron and steel castings in 1975. Foreign demands, arising from industrial expansion in the more advanced countries from the economic development of backward areas, may well call for increased exports from the United States, both directly in the form of steel-mill products and indirectly in the form of goods containing steel.

To meet these demands, it is possible that as much as another 10 million tons of ingots may be required. Such increase would carry the total ingot requirement to 150 million tons and the total iron and steel requirement, including castings, to 185 million tons. These estimates suggest that requirements in 1975 may be about 55 per cent larger than they were at the middle of the century.

ADDITIVE METALS

Manganese. The principal use of manganese is in the production of ordinary carbon steel, and use expands directly with steel output, so that by 1975 the free-world demand is expected to be roughly 60 per cent greater than in 1950. If steel production in the United States approaches 150 million tons by 1975, the corresponding manganese requirement under current practices will be about 2.5 million tons of ore of the grade now being used (46 per cent average). If allowance is made for some increase in the proportion of high-manganese steels, 2.7 million tons may be required. Under present development plans, the free world's manganese output can probably increase from 3 million tons of high-grade ore annually to about 4 million tons. Expansion would demand major new mining projects.

Other Additive Metals. United States demand for additive metals other than manganese—chromium, nickel, molybdenum, cobalt, tungsten, vanadium, and columbium—is expected to increase during the next 25 years at rates equal to or greater than the expected doubling of the national output of goods and services. The peacetime demand for cobalt is expected to quadruple that for molybdenum and tungsten to increase to more than $2^1/_2$ times 1950 consumption, and that for chromium and nickel approximately to double. Domestic supply and needs of molybdenum and vanadium should be substantially adquate in 1975, but dependence upon foreign sources for the other additive metals will probably continue.

NONFERROUS METALS

Copper. In spite of the expected substitution of aluminum and other materials for copper in many uses, the demand for copper in the United States can be expected to grow substantially over the next 25 years, possibly about 45 per cent as fast as the national output of goods and services. By 1975 a half million tons more than in 1950 may be required annually.

Strong efforts on the part of both government and industry will be required to sustain domestic mine output. Even with these efforts an average annual output of 800,000 tons a year, somewhat below the mine production of 1950 and 1951, is the highest that can safely be counted on over the next 25 years.

In 1950 the actual use of copper, both primary and secondary, in the United States was 1.7 million short tons.

In 1950 the rest of the free world consumed 1.3 million short tons of new copper; mine production was 1.6 million tons.

Lead. The demand for lead in the United States during the coming 25 years is expected to grow about 60 per cent as fast as the total national output of goods and services. Allowing for concomitant growth in scrap availability, an increase at this rate would by 1975 require about 200,000 tons more new lead per year than was available in 1950. Although vigorous efforts should be made by both industry and Government to maintain output, the best that can be hoped for is that domestic mine production will not decline by more than 50 per cent by 1975.

During the past 50 years apparent consumption in the U. S. just about quintupled. Mine production doubled during the first 25 years but subsequently declined, so that 1950 production was one third less than the peak in 1925. Production from scrap grew steadily, but did not entirely offset the decline in mine production. With domestic mine production for 1975 estimated at 300,000 tons at best, and scrap production at about 750,000 tons, fully one half of the total projected needs would have to be satisfied through imports.

In 1950 all other free countries together consumed about 844,000 tons of new lead and produced from their mines 1,214,000 tons. The demand for new lead in the rest of the free world is projected to grow by approximately 78 per cent, to a level of 1.5 million tons, by 1975.

Zinc. The demand for zinc in the United States can be expected to grow roughly two fifths as fast as the total national output of goods and services. Long-run domestic mine production, however, even under the stimulus of continued favorable prices and of measures to encourage exploration and production cannot be expected to exceed 700,000 tons per year, which is little more than the current level of output.

The United States supply of zinc in 1950 totaled 1,075,000 short tons. With the major exception of rolled zinc, the consumption of zinc in most uses is expected to rise through the period to 1957. If mineral exploration and production are successfully pursued, the industry should be able to maintain a rate of production of between 600,000 and 700,000 tons yearly through 1975, at about the present real cost of zinc. Scrap return around 1975 can be regarded as some 100,000 tons.

The 1950 consumption of new zinc in other free countries has been estimated at 1,061,000 short tons. Demand can be expected to continue to grow during the coming 25 years, possibly reaching a level of 1.7 million tons by 1975, an increase of 61 per cent over the 1950 level. In order to meet this demand along with indicated United States import needs of 800,000 tons, foreign free-world mine production would have to be on the order of 2.5 million tons, almost double the 1950 level of output.

Tin. The possibilities of continued production of newly mined tin, together with an expected increase of 18 per cent appear adequate to meet the demand. A tin stock pile is required against the threat of interruption to the flow of tin by war or political disruption. We must be prepared, in an emergency, to reduce the use of tin through redesign and respecification.

With the United States dependent on imports for almost 100 per cent of its supply of new tin, consumption of tin in the United States was about 93,000 long tons (71,000 tons of new tin plus 22,000 tons of old scrap). Demand here has been projected to increase somewhat over 25 per cent during the coming 25 years, from 93,000 tons in 1950 to about 118,000 tons by 1975.

Consumption of new tin in the rest of the free world in 1950 was 72,600 long tons; mine production was 163,000 tons. Net exports to the U. S. in the same year were 108,656 tons. Current production in the exporting countries was thus some 14,000 tons less than total consumption plus exports to the U. S., the difference being made up by drawing on stocks. Increase is pro-

jected at a level of 109,000 tons by 1975, or 50 per cent above new tin consumption in 1950.

The total free-world demand for new tin is estimated as rising to 193,000 tons by 1975, an increase of 18 per cent. The physical basis exists for expanding output in the major tin-producing countries to the needed extent, and the reserve situation is good, as is the expectation of future discoveries.

Aluminum. The United States and the rest of the free world are in a favorable position to meet the tremendous anticipated demand for aluminum. Not only are present uses expected to grow vigorously, but new uses will undoubtedly appear. Furthermore, if copper, lead, zinc, and tin continue in short supply or remain relatively expensive, aluminum can continue to be increasingly substituted for those metals, as well as for other materials.

Future demand for aluminum may quite possibly quintuple over the period 1950 to 1975, both in the United States and in the rest of the free world. Accordingly, by 1975 the United States consumption of primary aluminum might be in the neighborhood of 3.6 million tons and that of the rest of the free world about 2.4 million tons.

During 1950 the United States consumed 1,205,000 short tons of aluminum, including scrap. Aluminum consumption has grown ninefold in the past 25 years. Postwar consumption is now about four times that of 1940 and more would be consumed if available.

Magnesium. Magnesium can be obtained at moderate cost in unlimited amounts, but its large-scale use awaits technical improvements in alloying and fabricating the metal. Magnesium is the lightest of all structural metals in common use: two thirds the weight of aluminum and less than one fourth that of steel, and its largest use is as an alloy in aircraft construction.

Capacity of United States magnesium plants total about 130,000 tons. Domestic primary production may reach 500,000 tons in 1975. The market for magnesium in 1975 might be anywhere from 100,000 to 1,000,000 tons, depending on the technologic progress made. A national magnesium stock pile is required because of the great disparity between wartime and peacetime needs.

It is likely that other free-world countries will develop their industries beyond present token stages as the power shortages ease in Europe and as peacetime uses of magnesium become more prevalent.

Titanium. In view of many potential military applications for titanium and the strategic and tactical advantages that its use would afford, it is highly desirable that an intensive effort be made to develop large-scale low-cost production as quickly as possible. Output has increased from a few tons in 1948 to about 700 tons in 1951; by the end of 1952 the rate of annual production is expected to be on the order of 5000 tons. The demand for titanium over the next 25 years may therefore be either relatively small or fairly large, depending upon the speed and success with which technological problems are solved. The titanium industry will probably be operated on a small scale until better processes are developed and will look primarily to the Government for financial encouragement and for its principal market outlet.

Zirconium. In 1950 approximately 25,000 short tons of zircon were consumed in the United States, and about 25 short tons of pure zirconium metal. While estimates of reserves are little more than speculative, United States reserves alone are judged by industry and government experts to be ample for the next 25 years even should the demand for zirconium metal increase 50-fold by 1975 and all other uses should double. Free-world mining and concentrating facilities are ample and apparently could readily be expanded. Nevertheless, the national stock pile of zirconium ores must be retained as insurance.

RUBBER—NATURAL AND SYNTHETIC

The consumption of rubber in the United States can be expected to continue to grow vigorously, possibly doubling over the next 25 years. An even greater rate of increase can be expected in the other free countries, so that the total free-world demand for new rubber about 1975 may possibly be around $2^1/_2$ times 1950 consumption.

The total actual consumption of rubber in the United States in 1950, after adjusting for inventory changes, amounted to 1,620,000 long tons of new and reclaimed rubber, an all-time peak. Within that total consumption there were about 738,000 long tons of natural rubber, 582,000 long tons of synthetic rubber, making a total of 1,320,000 long tons of new rubber, and 300,000 long tons of reclaimed rubber.

United States consumption of rubber, new and reclaimed, may reach 3.3 million long tons by 1975. Reclaimed-rubber production may be expected to supply about 800,000 long tons by 1975, compared with 313,000 in 1950. Given a projected total demand of 3.3 million long tons by 1975, and reclaimed-rubber production of 800,000, new rubber supplies would have to be some 2.5 million tons.

In 1950 consumption of rubber in other free countries amounted to some 950,000 long tons, of which about 785,000 was natural rubber, 125,000 reclaimed, and 40,000 synthetic. On the supply side, natural-rubber production was about 1,855,000 long tons; synthetic 58,000; and reclaimed about equal to its consumption, 125,000 tons. The excess production of 1.1 million tons, mostly natural rubber, covered net shipments to the United States and countries outside of the free world. It is possible that the 1950 rate of natural-rubber production, 1,855,000 long tons, could be doubled by 1975.

Taken together, free-world demand for new rubber, as projected, would total some 5 million long tons by 1975. If natural-rubber production does expand to what appears to be the most reasonable outside limit of 2.5 million long tons by 1975, and if the total amount is available to the free world, synthetic-rubber supply would need to provide 2.5 million long tons by 1975 (50 per cent of new rubber consumption), as compared with slightly over one half million long tons in 1950 (25 per cent) and less than 1 million tons in 1951. In view of the United States' ability to expand synthetic-rubber capacity, no serious security-supply problems need be encountered during the next 25 years.

CHEMICALS

The chemical industry differs from other industries chiefly in the fact that it has tremendous flexibility, both in the raw materials it utilizes and in its processing techniques. It has a unique facility for processing abundant raw materials not only into products suitable as substitutes for other materials, but also into new materials having new properties and superior to anything previously known.

The quantity of prime and intermediate chemicals needed by 1975 to supply the basic needs will have to be nearly three, and perhaps four, times that consumed in 1950. In general, no long-range bottlenecks are foreseen for the basic materials.

Federal Research

FEDERAL agencies having grants and contracts for scientific research and development at nonprofit institutions made available for such programs a total of $297 million in fiscal year 1951 and $341 million in fiscal year 1952, according

to a preliminary analysis of information compiled by the National Science Foundation with the co-operation of all agencies engaged in research and development activities. Eighteen agencies reported research and development funds going to nonprofit institutions.

Funds administered by the Department of Defense made up over 50 per cent of the total in each year, compared with about 35 per cent for the Atomic Energy Commission, almost 6 per cent for the Federal Security Agency, and slightly less than 5 per cent for the Department of Agriculture. The remaining agencies accounted for less than three per cent of the total.

Information was obtained on the total funds by broad scientific fields and by character of scientific work supported, including basic research, applied research, development, and increase of research and development plant.

In 1951 funds reported for all agencies totaled $220 million in the physical, mathematical, and engineering sciences, $66 million for biological, medical, and agricultural sciences, and $11 million for social sciences. In 1952 comparable figures were $255 million, $70 million, and almost $17 million, respectively.

Obligations for basic research totaled $76 million in 1951 and $71 million in 1952; for applied research, $144 million in 1951 and $173 million in 1952; for development, $54 million in 1951 and $77 million in 1952; and for increase in research and development plant, $23 million in 1951 and $20 million in 1952. The figures thus indicate that there has been an increase (20 per cent) in Federal funds at nonprofit institutions for applied research and development and a slight decrease for basic research.

This information is needed by the Foundation in connection with the study of the impact of present support and policies of the Federal Government upon research and education in the nonprofit institutions of the country. This and other information on Federal research programs is being gathered by the Foundation in partial fulfillment of its statutory responsibilities with respect to scientific research. These reports will be of considerable value to all concerned in the administration and planning of Federal research and development programs for fiscal year 1953 and subsequent years. They should also be of interest to groups outside the Goverment concerned with the effects of Government research policies.

Agencies co-operating in the study included the Departments of Agriculture, Commerce, Defense, Interior, Labor, and State, and the Atomic Energy Commission, Federal Civil Defense Administration, Federal Security Agency, Housing and Home Finance Agency, Library of Congress, National Advisory Committee for Aeronautics, National Security Resources Board, Office of Defense Mobilization, Reconstruction Finance Corporation, Tennessee Valley Authority, and Veterans Administration.

Continuous Coal Mining

A COMBINATION mining rig and continuous-mining machine forms the new continuous coal-mining system developed by Carbide and Carbon Chemicals Company, New York, N. Y., for handling coal in outcrop seams. For this type of seam, preparation for coal removal is relatively simple. A working shelf is cleared at the level of the outcrop, and the mining rig takes over.

The mining rig is a self-propelled double-decked steel structure. On the first deck is a runway or launching platform for the mining machine. In the center of the runway is a coal conveyer. Adjacent to it are a control panel for moving the whole rig, and an enclosed cab that houses the remote controls for the mining machine. On the second deck are the cable reels for the power and control cables that guide the machine and electric switchgear.

This whole structure is mounted on four hydraulic jacks, which can be adjusted so that the launching platform is at the proper height for the mining machine to enter the seam. In order to move along the face of the seam, these jacks are raised enough to allow rails suspended from the undercarriage to be rolled out by an electrically driven winch. The jacks are let down until the rig rests on wheels on the rails and the four hydraulic jack pads are off the ground. Then the winch pulls the rig over to the next position. If the exposed face is irregular, the rails can be pivoted until the platform is at the correct angle. When the platform is in position, the hydraulic jacks are raised to support it at the proper height.

The mining machine is mounted on crawler tracks, which are driven by a variable-speed electric motor. Its "business end" consists of four overlapping cutting heads with cutting teeth that are tipped with tungsten carbide. The sections between the holes cut by these heads are shaved off by fixed cutter blades just slightly to the rear of the heads. Between them, the heads and the blades make a smooth even hole about 10 ft wide and 3 ft high. By making successive cuts, the full height of the seam can be mined.

Behind the outer cutting heads revolving on the same shaft are paddles that move the coal cuttings to the middle, where they are picked up by the central flight conveyer and carried from the front to the rear of the machine. From the fixed cutter blades back, the whole cutting end is encased in a metal shield, so that the coal can escape only by means of the machine conveyer.

To begin mining, the rig carrying the machine on its launching platform is located at the proper angle and height. If the launching platform does not abut the seam face, the gap is bridged by extending two telescoped sections of the runway. The operator starts the cutting heads and conveying system and then moves the machine ahead on its crawler tracks. First, the pilot drill taps the coal and starts sinking the pilot boring. In a few moments the main cutting heads reach the seam and begin to bite. They crack the coal into small pieces that are pushed by the paddles and carried up through the middle of the machines on the conveyer.

At the rear of the machine, the coal falls from the central

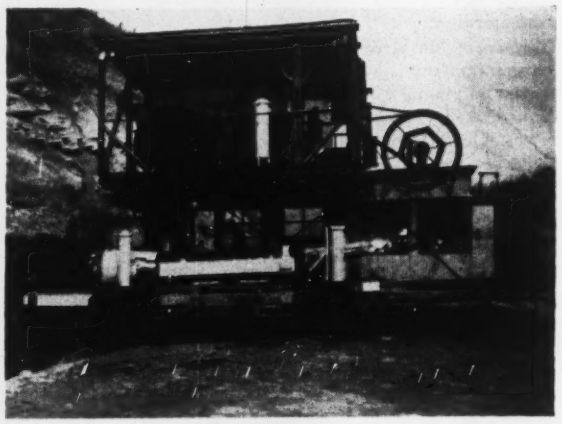


FIG. 1 MINING RIG WITH THE FOUR HYDRAULIC JACKS RAISED TO PROPER HEIGHT FOR THE MINING MACHINE TO BEGIN THE FIRST CUT OF A NEW BORING

(Note the power cables coming down to the machine from the reels on the second deck.)

flight conveyer to the conveyer in the launching platform. The continuous stream of coal flows along the rig conveyer to a short transfer conveyer, which feeds the elevating conveyer of the truck-loading hopper. From this point, it travels by 20-ton trucks to the hopper at the let-down conveyer to the storage pile.

When the mining machine is almost underground, the rear of its central flight conveyer reaches the end of the platform conveyer. At this point, the machine is stopped and a portable conveyer is added. Each of these conveyers is about 30 ft long and is mounted on two pneumatic tires located at the rear

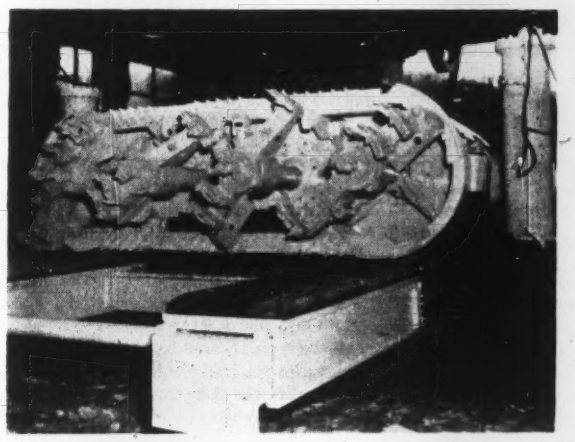


FIG. 2 BUSINESS END OF CONTINUOUS MINING MACHINE HAS FOUR OVERLAPPING CUTTING HEADS, AND FIXED CUTTER BLADES AT THE TOP AND BOTTOM

(Behind the outer two heads are the paddles that move the coal to the central flight conveyer.)

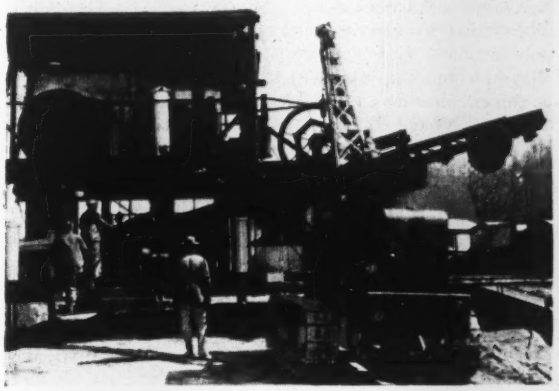


FIG. 3 ONE OF THE 30-FT-LONG PORTABLE CONVEYERS IS SWUNG INTO POSITION ON THE LAUNCHING PLATFORM OF MINING RIG

end. The front end of the portable conveyer is attached to the mining machine, which now will both mine the coal and haul the train of conveyers. At the rear of the conveyer the cable is plugged in to supply power for the motor that drives the belt. To prevent fouling or dragging the mining-machine power cables, each conveyer has large L-shaped hooks on its side for carrying them as they come down from the reels on the second deck of the rig.

As each portable conveyer reaches the end of the platform

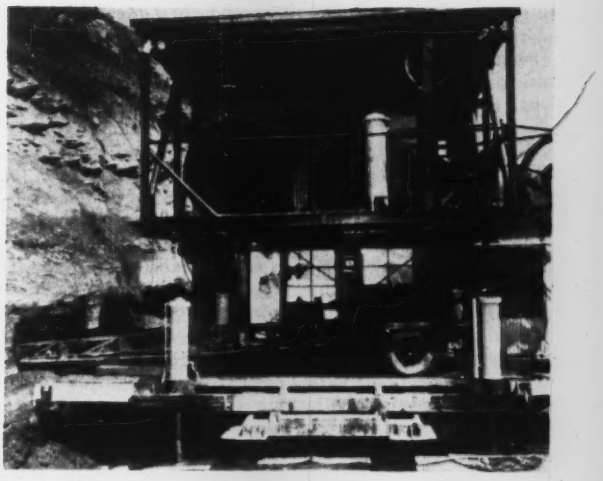


FIG. 4 MINING MACHINE AND FRONT END OF THE FIRST PORTABLE CONVEYER ARE UNDERGROUND

conveyer, another is added. Actually, this operation takes only a couple of minutes, because the conveyers are brought in overhead by a tractor-mounted crane that suspends each portable conveyer just above the rig conveyer until it is needed. The number of conveyers added depends on the depth of the hole being bored.

When the machine has bored as deeply as desired, the electric motors are reversed and the machine pushes instead of pulls its train of portable conveyers. The train is unhitched the same as it was assembled.

Finally, the machine itself backs out into the daylight on the launching platform. This part of the operation is much quicker, since the machine can be backed at 30 fpm.

If the thickness of the seam warrants, the four hydraulic jacks are let down until the platform is in position to make a second cut below the first. When the seam is not thick enough to permit a full three-foot bite on the second boring, the coal is kept flowing at the same rate by increasing the forward speed of the machine.

The operators of this machine are always above ground, and they have little or no actual contact with coal. Yet the underground machine they control sends out by way of conveyers up to $1^2/_3$ tons of coal a minute. The size of this coal ranges up to four inches, and the percentage of fines is not different from other coal mined mechanically.

During the machine's best eight-hour shift, 567 tons of coal poured off its conveyer. In one continuous 24-hr day, it has mined 1200 tons, and in one continuous week, as much as 6000 tons. This production recovery represents a recovery of about 65 per cent.

Coal Research

THE sixteenth annual summary on coal research, revealing continued progress in the fields of synthetic liquid fuels, safety, mining and utilization efficiency, and appraisal of the nation's reserves of coking coal, has been released by the U. S. Bureau of Mines, Pittsburgh, Pa.

According to the report, the Bureau's research in the mining, preparation, and utilization of coal has been aimed at gaining more complete information on the extent and quality of coal reserves, encouraging safer and more efficient mining practices,

and preparing and consuming coal to the best advantage, now and in the future.

Investigation of recoverable reserves of coking coal was continued during the year in central and southern Pennsylvania, southern West Virginia, and eastern Kentucky to provide information on potential sources of metallurgical coke needed to maintain high rates of steel output.

The federal investigation disclosed recoverable reserves of 3662 million tons of coking coal in beds 28 in. or thicker in Cambria and Indiana counties in western Pennsylvania and Pike county in eastern Kentucky. Associated studies in the laboratory indicated which coals were suitable for metallurgical use or could be made so by conventional washing methods or special treatments and determined the yield and quality of coke and chemical products for selected coals.

Of special interest, the report states, was the completion of the firing stage of the second underground gasification experiment, conducted jointly by the Bureau and the Alabama Power Company at Gorgas, Ala. Some of the advantages that may be realized from this type of operation are: A reduction in invested capital costs and over-all labor requirements, the recovery of the energy of coal in an easily used form, and the utilization of coal deposits that are too thin to be mined.

The Bureau's synthetic-liquid-fuels research progressed with studies of the mechanism of synthesis-gas production, hydrogenation of coal, catalyst investigations, and production, separation, and identification of coal-hydrogenation and synthesis-gas products.

The government's coal-hydrogenation demonstration plant at Louisiana, Mo., completed several successful tests and much of the gasoline produced has been used in Army vehicles with satisfactory results.

The Bureau prepared detailed cost estimates for planning commercial synthetic-liquid-fuel plants to suit specific conditions as interest mounted in the economic aspects of the production of gasoline, Diesel oil, and a wide range of chemicals from coal.

One of the many other interesting activities discussed in the annual report is the Bureau's co-operation under the Point-Four program in extending technical assistance on coal mining and preparation to representatives of South American countries.

Improvement in coal-mine safety was shown, according to the report, in Bureau studies of coal-mine explosions, fires, and fatalities, and the major causes and ways of avoiding these accidents are pointed out. To determine the efficiency of coal-mine ventilating systems, Bureau laboratories analyzed approximately 14,000 samples of mine air. More than 1600 dust-concentration and particle-size determinations were made and various types of electrical mine equipment were tested to determine whether they are safe to use underground.

Continuing its services to other Federal agencies, the Bureau of Mines helped them effect substantial savings by furnishing advice on the purchase of fuels and consulting with them on fuel-engineering problems. For this purpose, analyses were made of 10,850 samples of coal and coke from government purchases. The Bureau also advised many municipalities on smoke-abatement problems.

Anthracite mining research, which centered at the Bureau's Anthracite Subregional Headquarters at Schuylkill Haven, Pa., developed safer and more efficient mining methods in Pennsylvania's hard-coal area, and showed that a German lightweight cutting machine can be adapted to steep-pitch mining. Roof-control problems and mine floodwater dangers in the Anthracite region were studied also.

Commercial development of the first Diesel mine locomotive to be approved under a Bureau of Mines safety schedule was brought closer by tests in Pittsburgh of three units and the working out of necessary modifications with the manufacturer.

A free copy of the publication, "Information Circular 7647—Annual Report of Research and Technologic Work on Coal, Fiscal Year 1951" can be obtained from the Bureau of Mines' Publications-Distribution Section, 4800 Forbes St., Pittsburgh, Pa.

Steam-Electric Stations

THE world's two largest steam-electric generating stations are to be erected on sites on the Ohio River at Madison, Ind., and near Gallipolis, Ohio, it was announced by Philip Sporn, Fellow ASME, president of the Ohio Valley Electric Corp., recently formed by 15 electric utilities of the Ohio Valley Region. They will supply the full electric power requirements of the Atomic Energy Commission's billion-dollar uranium-diffusion plant to be built near Portsmouth, Ohio.

Construction of the plant near Gallipolis will be handled by the Ohio Valley Electric Corp. and of the Madison plant by the Indiana-Kentucky Electric Corp., an Ohio Valley subsidiary.

Cost of the two electric power stations, plus the transmission and related facilities required to deliver energy to the AEC's Portsmouth project, will be an estimated $400,000,000. For the individual plants alone, the estimated costs will be: Indiana plant, $175,000,000; Ohio plant, $145,000,000.

Combined capacity of the two plants will be 2,200,000 kw, of which 1,800,000-kw has been contracted for by the AEC for a 25-year period. This represents the largest single block of power ever supplied to a single customer in the history of the electric power industry. The balance of capacity is considered necessary for attendant losses of power in transmission and for reserve capacity generally considered adequate for regular maintenance and overhaul. During abnormal emergencies the capacity will be further supplemented by about 200,000 kw from the sponsoring companies.

The Indiana plant will consist of six turbogenerating units of 200,000 kw each, or a total of 1,200,000 kw. The Ohio plant will have five units of the same capacity, or a total of 1,000,000 kw.

Engineering companies which have been selected to carry out the engineering and design of the two plants include the American Gas and Electric Service Corporation of New York, N. Y., and Sargent & Lundy of Chicago, Ill. While the planning of the two groups will be closely co-ordinated in all principal features of plant design of the project as a whole, American Gas and Electric Service Corporation will carry out the principal design work on the 1,200,000-kw power station, and Sargent & Lundy will perform the corresponding work in the 1,000,000-kw power station.

The first 200,000-kw unit at the Indiana plant is scheduled to be in operation by January, 1955. Thereafter a staggered schedule of completion dates for remainder of the individual units will bring all 11 of them on the lines at intervals up to June, 1956, according to present plans.

When in full operation, the two power stations are expected to provide the AEC project a total of 15,000,000,000 kwhr annually, or roughly 25 per cent greater than the present consumption of New York City with its 8,000,000 people. It also is roughly two thirds of the electric power consumption of the entire highly industrialized state of Ohio, which in 1951 totaled slightly more than 22½ billion kwhr.

It is estimated that more than 7,000,000 tons of coal annually will be needed at both plants. Coal storage yards for reserve purposes at both sites will be among the largest in the country and will be developed to hold up to 3,000,000 tons of coal.

The coal is to be supplied by five Midwestern coal companies.

Three companies will supply coal to the Indiana plant: Ayreshire Collieries, Indianapolis (Republic Coal & Coke Co., Chicago, sales agent), 1,780,000 tons per year; Sinclair Coal Co., Kansas City, 1,780,000 tons; and Green Coal Co., Owensboro, Ky., 395,000 tons.

Two coal firms will supply the Ohio plant: North American Coal Co., Cleveland, and Pittsburgh Consolidated Coal Co., Pittsburgh, each 1,550,000 tons per year.

Total contracted tonnage of 7,055,000 will cost an estimated $25 million a year, in addition to transportation charges of about $4 million.

Mr. Sporn said that electric power generated at the two stations will be delivered over 330,000-volt transmission lines to be constructed to the AEC project. At 330,000 volts the transmission network will equal the highest voltage now planned anywhere in the United States.

Present plans call for construction of four 330,000-volt double circuits to the AEC project, two from each power plant. The two from the Indiana plant would be routed via a switching station to be built in the general area of Cincinnati. First of the four double circuits is scheduled to be completed by August, 1954, and all of them are due in operation by August, 1955.

In addition to the direct superhigh-voltage lines from the two power plants to the diffusion center, the supply of electric energy will be "backed up" by the existing integrated high-voltage electric transmission systems of the 15 participants in Ohio Valley Electric Corporation. Each company of this group is directly or indirectly interconnected with every other company in the group and all of them in parallel with other systems which together constitute the largest interconnected transmission network in the United States.

Construction power and power for operation of the atomic center up to 465,000 kw will be required before the new generating facilities can be completed. This will be supplied to AEC from existing systems of the companies and, to this end, one 132,000-volt line has been rushed to completion to the atomic plant site from a "tap" near Lucasville, Ohio, and a second is under construction from Waverly, Ohio. Later, as the quantities of interim power increase, some of the permanent transmission facilities will be completed and tied in with the sponsor companies' systems to meet those needs.

The 15 electric-utility sponsor companies are as follows: Appalachian Electric Power Company, Indiana & Michigan Electric Company, and the Ohio Power Company, all subsidiaries of American Gas and Electric Company; Monongahela Power Company, West Penn Power Company, and Potomac Edison Company, all subsidiaries of The West Penn Electric Company; Ohio Edison Company; Pennsylvania Power Company, subsidiary of Ohio Edison; The Cincinnati Gas & Electric Company; Columbus and Southern Ohio Electric Company; The Toledo Edison Company; Louisville Gas and Electric Company; Kentucky Utilities Company; The Dayton Power and Light Company; and Southern Indiana Gas and Electric Company.

Submarine Reactor Building

COMPLETION of the saucer-shape foundation for the 225-ft steel sphere that is to house a nuclear submarine power plant being built by the Atomic Energy Commission for the U. S. Navy has been announced, and work on assembling the hull of the land-based prototype submarine is under way, according to the Schenectady Operations Office of the AEC and the General Electric Company.

Known as the Submarine Intermediate Reactor (SIR), this project is under the direction of the Knolls Atomic Power Laboratory operated at Schenectady for the AEC by the General Electric Company. The reactor, and the sphere enclosing it, are being built on a 4000-acre site at West Milton, N. Y., about 18 miles north of Schenectady.

The spherical design of the reactor building was adopted to give additional protection to operating personnel and to off-site areas during test operations beyond the many safety controls of the reactor itself.

Similar structures are widely used in the chemical and petroleum industries, but the West Milton sphere will be the largest ever constructed. In the remote event that simultaneously all other controls failed, the resulting release of radioactive material would be contained in the sphere which will have a net "free" space of more than 5,400,000 cu ft.

The outer periphery of the building will be 706 ft. The sphere will rest on the concrete saucer just completed which is 179 ft in diam and 42 ft deep. A ring of steel columns set on concrete outside the structure and reaching to the middle of the sphere will give further support to the building. Welded steel plates will make up the skin of the ball. The plates will be hoisted into position by a derrick mounted on top of a temporary central steel tower. The derrick, now in place, reaches to 424 ft above ground level.

Every weld in the structure must be x-rayed to assure that there are no leaks. To do this, on the bottom, a four-ft space is provided temporarily between the base of the sphere and the concrete saucer. After testing is completed, this space will be filled with concrete and aggregate. Inside, the concrete floor on which the reactor will rest will be slightly above ground level and the well of the saucer beneath the floor will be filled with compacted mixture of aggregate and earth. The reactor building will be air-conditioned.

As soon as the columns are in place, the first ring of plates will gird the sphere at its center and assembly will proceed both upward and downward.

Meanwhile the hull of the submarine will be assembled just outside the building and when the latter is completed and tested, the hull will be skidded into the huge ball through a special wall section and the sphere again sealed.

The Submarine Intermediate Reactor is one of two nuclear-science approaches being made to the problem of utilizing atomic fuel for underwater ship propulsion. The other is incorporated in a project at the National Reactor Testing Station in Idaho. The reactor designed for the West Milton site will use liquid-sodium metal to take the heat out of the reactor core and into an exchanger or "boiler" where water will be converted to steam. The steam will then drive the turbines that propel the submarine.

New Synthetic Tire Rubber

IF a new type of GR-S synthetic rubber, now in the pilot-plant stage, becomes a production reality, greater tire wear is a distinct probability in the near-future.

Developed by the scientists of the Naugatuck Chemical Division, United States Rubber Company, existence of the new rubber was first reported in a paper presented by Dr. L. H. Howland, director of synthetic rubber research and development, J. A. Reynolds, and R. L. Provost, before a recent meeting of the American Chemical Society.

Laboratory tests, Dr. Howland reported, show that the new synthetic gives 30 to 50 per cent more abrasion resistance than standard "cold" rubber. It also has good resistance to heat, cracking caused by rapid flexing, and the deteriorating effects of aging in air.

Preliminary road tests for tires made with the rubber appear to be confirming the improvements found in the laboratory, although no final answer has yet been determined, Dr. Howland said.

The new rubber is made possible by the addition of resin chemicals, by-products of turpentine manufacture, to an extra-tough cold type of GR-S synthetic rubber.

The resin chemicals make the rubber easier to fabricate into products and improve its end-product qualities, Dr. Howland said.

The chemicals are added to the rubber when it is in the latex or liquid form. Carbon black, the principal reinforcing agent for rubber, may also be added at the same time.

2400-Hp Diesel Locomotive

A 2400-HP single-engine Diesel locomotive was announced recently by Fairbanks, Morse & Company in New York, N. Y. Called the "Train Master," it is designed as a universal locomotive to handle a wide variety of railroad jobs, from 80-mph passenger runs to high-tonnage freight hauls.

The new locomotive, the company said, has the highest starting tractive effort, the highest pulling power, and the highest braking power ever achieved in a single locomotive.

The power plant is the 12-cylinder, 2400-hp F-M opposed-piston engine. Cooling, lubricating, and fuel systems, as well as most of the working parts of the engine, are the same as those used on other Fairbanks-Morse locomotives to provide the maximum interchangeability of parts between the Train Master and other Fairbanks-Morse units already in operation on many American railroads.

The main transmission components are taken directly from the 2400-hp F-M road-locomotive models, and to this is added the driving power of two additional traction motors—for a total of six driving axles. This transmission provides the highest continuous-tractive-effort ratings per axle available for railway traction. The following three optional gear ratios are available for selection of the most suitable range between maximum continuous tractive effort and maximum speed:

Gear ratio	Max. speed	Continuous rating T.E. at mph
68:15	65	78,750 lb 9.2
63:15	70	72,900 lb 9.9
62:17	80	63,300 lb 11.4

This transmission and the Diesel engine provide power and tractive force that is said to be at least 50 per cent greater than available in the conventional 1600-hp four-driving-axle locomotive.

The ready-to-run weight available on all drivers of 375,000 lb equally distributed to the six driving axles assures adequate adhesion for full utilization of the power in the Train Master.

Various combinations of equipment and ballast are possible to obtain the correct weight for the best advantage in starting and moving heavy trains over ruling grades.

The capacity of the wheels to transmit force to the rails through friction is closely matched by the capacity of the transmission to develop continuous tractive force.

The Train Master, the company reported, provides 50 to 60 per cent more power, 50 to 90 per cent more continuous rating, and 50 per cent more weight on drivers in a single unit as compared with any 1500-hp or 1600-hp four-motor, four-axle Diesel locomotive now in service.

Variable operating supplies have been arranged for equal distribution of weight on drivers. The 1800-gal fuel capacity is 50 per cent greater than that offered on any other locomotive. The sand capacity of 48 cu ft is the largest available in any single Diesel unit. The train-heating water capacity of 2400 gal is also at least 50 per cent greater than previously available on any other locomotive.

Train-heating capacity of the new locomotive, expressed in terms of steam-generator evaporative capacity is 4500 lb of steam per hr utilizing the largest steam generator available for locomotive service. This capacity is adequate for comfortably heating up to 15 cars in zero weather.

The station-to-station time for this combination of boiler and water capacity is more than is required on most railroads—an important factor in nonstop passenger operation.

The dynamic brake equipment has been proportioned to fully utilize the capacity and characteristics of the traction motors—3000 hp is dissipated at the rail by each Train Master unit over the braking speed range. This is approximately 50 per cent more than the rail horsepower of the Train Master when pulling. This high dynamic brake capacity is from 50 to 100 per cent greater than that of other 1500-hp or 1600-hp four-axle locomotives now in service.

The Fairbanks-Morse Tri-Mount Truck is a six-wheel three-motor truck. Features of this truck have been thoroughly tested and proved, not on selected locomotives or test cars, but in general heavy-duty service on all types of motive power and rolling stock. The result is a truck that combines maximum tractive effort, high braking power, and three-way ride control with simplicity of construction, a minimum of moving parts, and most important of all, maximum accessibility.

The general arrangement and construction of the Train Master is laid out to obtain the proved advantages of easier maintenance, better visibility, and high degree of versatility of the hood-type locomotive. Numerous doors offer access to all parts of the locomotive requiring service or maintenance. The hood-

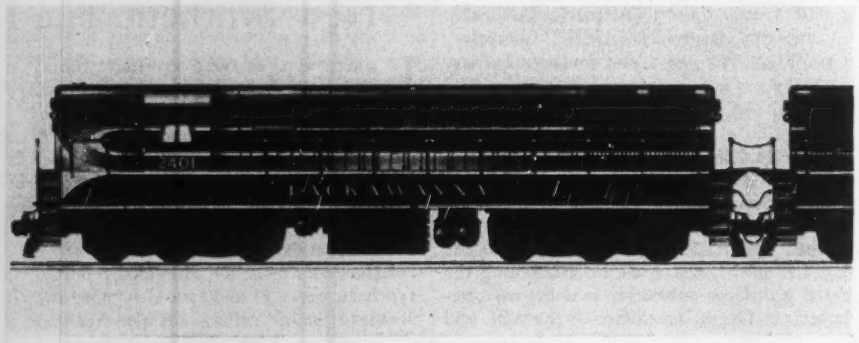


FIG. 5 FAIRBANKS-MORSE 2400-HP TRAIN MASTER DIESEL-ELECTRIC LOCOMOTIVE

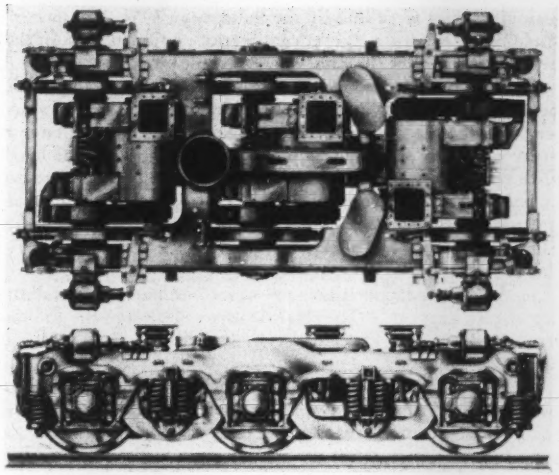


FIG. 6 NEW FAIRBANKS-MORSE TRI-MOUNT LOCOMOTIVE TRUCK FEATURES THREE-WAY RIDE CONTROL, HIGH TRACTIVE EFFORT, HIGH BRAKING POWER, FEWER MOVING PARTS, AND MAXIMUM ACCESSIBILITY

type construction offers good visibility both forward and back. The inclusion of switchman's footboards, hand railings, and grab irons, and the like, makes this locomotive available for use in those services requiring frequent switching.

All of the latest improvements in air flow, filtering, and ventilation have been included in the design to assure clean cool air for all air-cooled or air-consuming parts of the locomotive, thus improving all operating characteristics.

The general arrangement is such that the short hood will be the forward end of the locomotive, affording maximum visibility. This is optional, however, and the reverse arrangement of cab control will be provided. Moreover, two control stations can be provided for operation in either direction from the right side in high-traffic-density areas.

It was announced that the first ten Train Masters to be built will be delivered to the Lackawanna Railroad. The locomotives are being built at the Fairbanks-Morse's Beloit, Wis., Works, and the first unit will be ready for delivery early this year.

Rapid Gas Sampler

A FAST-ACTING mechanical device that takes samples of a rapidly changing gas over extremely short intervals—0.2 millisec or less—has been developed recently at the National Bureau of Standards. Designed for use in research on the mechanism of engine "knock," the new gas sampling valve is particularly well adapted to studies of the complex changes that take place in the combustion chamber of an automotive engine.

With the co-operation of the Army Ordnance Department, the Bureau is now studying the reaction kinetics of knocking combustion in an effort to obtain information that will make possible more efficient utilization of automotive fuels. A single-cylinder test engine, in which a wide range of operating conditions may be simulated, has been constructed, and the data thus obtained on the igniting fuel-air mixture are being used to correlate the knocking characteristics of fuels with their chemical structure.

In order to obtain significant data on the chemical processes taking place in the cylinders, some knowledge is required of the proportions of reactants and products present at various times during the combustion cycle. However, multistage combustion reactions of this type are especially difficult to study because of the very short duration of each stage (between 0.1 and 1 millisec), the extreme complexity of the reaction mechanism, and the fact that many of the important particles are free radicals whose half-lives are probably 1 millisec or less. Thus, if the combustion gases are to be sampled, the samples must be taken over extremely short intervals during a single cycle of operation, and the reaction must be frozen almost completely upon removal of the sample from the combustion chamber. At the same time, the samples must be large enough for a complete analysis in a mass spectrometer, and the length of the sampling interval must be accurately known to permit correlation between the gas composition and the other measured quantities. The NBS gas sampler was developed to meet these requirements.

Essentially, the sampling valve consists of a flanged piston which moves in an evacuated chamber. The valve chamber is connected at its upper end to a vacuum pump and an evacuated sample container. Its lower end first widens abruptly and then narrows to form a connection with the combustion chamber. Initially, the valve is closed manually by pressing the piston down so that its lapped flange seats against the edge of the combustion-chamber opening. The short length of piston below the flange extends into the opening, completely sealing it off. The valve is held in this position by a trigger device external to the valve chamber. When the trigger is released by a solenoid mechanism, the pressure of the gases in the combustion chamber accelerates the piston upward through the valve chamber so that it is moving with appreciable velocity by the time its lower edge passes out of the combustion-chamber

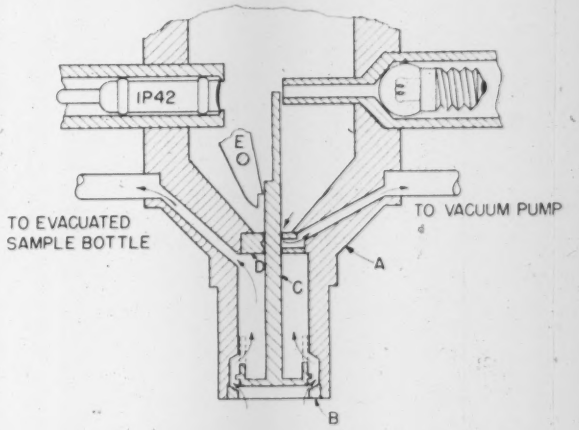


FIG. 7 CROSS-SECTIONAL DIAGRAM OF THE RAPID-ACTION GAS SAMPLER DEVELOPED AT THE NATIONAL BUREAU OF STANDARDS

[The body (A) of the valve is designed to fit a 7/8-in. spark-plug hole. In the initial, closed position, the lapped flange of the piston (C) is pressed against the lower seat (B) of the valve by the trigger (E). When the trigger is released by a solenoid-operated mechanism, the pressure of the gases in the cylinder accelerates the piston upward. The cylinder gases then pass around the piston head, and continue to do so until the upper edge of the head passes the upper seat. The upper seal is complete when the flange is seated in the top position. Passage of light from the flashlight bulb (upper right) to the 1P42 photoelectric cell is cut off by the extension of the piston shaft, producing on an oscilloscope screen a square wave which indicates the time of opening and closing of the valve. During operation the entire system is evacuated to less than 0.01 mm of mercury. The groove in bushing D is connected directly to the vacuum pump so that any atmospheric leakage between the piston shaft and guide will not reach the sample bulb.]

opening. At this time the cylinder gases begin passing around the piston head and continue to do so until the upper edge of the head passes into the smaller-diameter upper portion of the valve chamber. The flange then causes the piston head to seat at this point, completely closing the valve. If bouncing occurs, it is not sufficient to cause the valve to reopen.

While the piston is rising, the connection to the vacuum pump is kept closed so that all the combustion gases pass into the sample container. Meanwhile, an extension of the piston shaft progressively cuts off the passage of light from a flashlight bulb to a small 1P42 photoelectric cell. Thus, when the output of the phototube is differentiated, a square wave indicating the time of opening and closing of the valve is obtained on the screen of an oscilloscope used to present pressure changes within the cylinder. Any bouncing or reopening that might occur would also be made visually evident in this way.

In general, the duration of valve opening and the total mass of gas admitted are dependent upon cylinder pressure at the time of the valve opening. Thus, for example, if the pressure is 80 psi, about 1 mil of gas (reduced to standard temperature and pressure) will flow in 0.2 millisec, while at 500 psi the flow is approximately 4 mil in 0.1 millisec. This decrease in the duration of sampling with increasing pressure is advantageous inasmuch as the reactions studied occur more rapidly at the higher densities.

Air Conditioning

SOME enlightening facts and figures about the air-conditioning industry were given by Cloud Wampler, president, Carrier Corporation, Syracuse, N. Y., at a recent New York City preview showing of Carrier's new 1953 room and year-round residential air conditioners.

Noting the growth of the industry since World War II, Mr. Wampler cited the following industry shipment figures of room air conditioners: 1946, 30,000; 1947, 43,000; 1948, 74,000; 1949, 89,000; 1950, 201,000; 1951, 237,000; 1952, 325,000 (estimate).

The foregoing figures, he pointed out, involve factory shipments rather than retail sales. In 1951 more room air conditioners were made than sold. Thus there was a carry-over and because of this actual sales during 1952 will probably total 362,000 units—or some 80 per cent above the 1951 figure. And the prospects are for a further increase to 450,000 or thereabouts in 1953.

At present there are probably 500,000 room air conditioners in American homes. Ten years from now, Mr. Wampler believes, there will be at least one room air conditioner in 5,000,000 of these homes. And this will be on top of the huge number that will be purchased for office and other business usage.

Impressive as the room air-conditioner story is, Mr. Wampler believes that there is at least an equal long-range opportunity in the field of year-round residential air conditioning for the following reasons:

1 True air conditioning involves more than a room unit can possibly produce. The so-called central unit does a better job, including both heating and cooling.

2 A home can be air conditioned not only better but cheaper by a central unit. Such a unit takes care of every room in the house; it provides all-room comfort, not one-room comfort.

3 The central unit does not create problems of decoration and is more easily serviced.

Turning to cost factors, Mr. Wampler pointed out the following facts:

1 Certainly 50 per cent more year-round residential air-conditioning units were sold by the industry in 1952 than in 1951. And Carrier expects a 100 per cent increase in its business of this type next year over the total of the present year.

2 Construction savings are a real factor. For example, the need for cross ventilation can be eliminated. Windows and walls can be placed wherever you want them; you can have as many or as few windows as you wish and they may be fixed, with real money savings. Equally important is that there can be more solid walls at much less cost. And these provide greater privacy and more space for built-in or other furniture. Then too, a solid wall affords the solution for many a property-line problem.

3 An air-conditioned home is a clean home. Dust and dirt are largely kept out. The result is lower cleaning bills and less frequent decorating expenditures. And cleaner air is healthier air.

4 The air-conditioned home is much quieter. There is no need to open the windows. And with freedom from noise there is also greater privacy and greater comfort.

5 Speculative builders are now using air conditioning as a primary sales tool. They have found out two things: People want air-conditioned homes, and air-conditioned homes can be built to sell for as little as $11,500.

Mr. Wampler prophesied that very soon now air-conditioned homes will be generally available as low as $10,000. This will mean a real mass market. Furthermore, he believes that before very long speculative builders will place their bets only on fully air-conditioned dwellings.

Gas-Turbine Pumping Stations

ACCORDING to Paul Kayser, president of the El Paso Natural Gas Company, El Paso, Texas, the gas turbine is now being used successfully to pump natural gas through pipe lines.

Mr. Kayser revealed that the first of 28 5000-hp General Electric gas turbines for the El Paso gas-transmission system between West Texas and California has been placed in operation at Cornudus, Texas.

When the remaining units are in operation within the next year, flow of gas through the lines will be increased about 300 million cu ft per day.

The new gas turbines will operate centrifugal pumps to obtain this increase in capacity. The El Paso system is now using stations with reciprocating pumps at about 100-mile intervals along the line. These units will continue to be used.

The gas-turbine stations are being inserted at about 30-mile intervals between existing reciprocating stations to boost the average pressure and the flow of gas.

Mr. Kayser said that operating cost of the new stations is expected to be less than the cost of present reciprocating stations, principally because the new stations will require less manpower for operation and maintenance.

Sites of the new stations are in the desert where water is a precious commodity. Gas turbines are well-suited to such locations because they require little water and few operating personnel.

The gas turbines are being installed as part of the expansion program of the El Paso Natural Gas Company.

General Electric officials in Dallas said that the order for gas turbines is the largest single order ever received for this type of equipment. Nine of the units are already being installed and some are already in operation. The remainder are scheduled for shipment by March of this year. All the gas turbines are expected to be in operation before the end of 1953.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

High-Temperature Steam Generation

Laboratory Investigation of Superheater Tubing Materials in Contact With Synthetic Combustion Atmospheres at 1350 F, by C. J. Slunder, A. M. Hall, and J. H. Jackson, Battelle Memorial Institute, Columbus, Ohio. 1952 ASME Annual Meeting paper No. **52—A-36** (mimeographed).

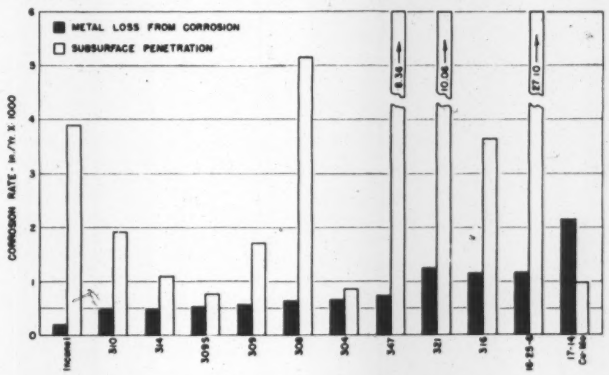
THE resistance of 12 commercially available alloys to gaseous combustion products at 1350 F was evaluated in a series of eight 1000-hr laboratory tests. Two concentration levels of sulphur dioxide, carbon monoxide, and alkali were tested in all possible combinations to show the effects of these variables in controlled experiments, and to determine the surface stability of the metals for superheater tubing use at 1350 F metal temperature in a variety of combustion atmospheres.

Conditions selected for these tests were not sufficiently severe to cause excessive scaling, and any observed differences between the various metals under any of the given conditions were of a minor order of magnitude. The mean corrosion rate was determined for each alloy by averaging the results of the eight tests. From the standpoint of metal loss only, Inconel showed the least attack, and followed closely by a group consisting of AISI 310, 314, 309, and 309S. Only four alloys, AISI 316, 321, 17–14 Cu-Mo, and 16-25-6, lost more than 0.001 in. per year from surface corrosion.

Extent of penetration by subsurface attack was also determined for the alloys by metallographic examination of cross sections of the specimens. Subsurface attack was shown to penetrate to a considerably greater depth than scaling attack on many of the alloys. The best combination of low metal loss and minimum subsurface attack was shown by alloys of the 25 Cr-12 Ni and 25 Cr-20 Ni types. AISI 304 (18 Cr-8 Ni) was also among the best on the basis of total depth of metal affected. This was not borne out by the field-test results, possibly because the corrosive conditions may have been more severe. Alloys 16-25-6, 321, 347, 308, and 316 showed the greatest subsurface attack. Inconel apparently is also subject to this type of attack.

With the afore-mentioned exceptions the laboratory-test results checked the field-test results in a general way. This is particularly true when considering only those units burning natural gas and low-sulphur coal. Conditions resulting from burning high-sulphur, high-vanadium fuel oil were not included in the laboratory tests.

A statistical evaluation of the metal-loss results indicated that the increase in corrosion caused by increasing the sulphur dioxide in the atmosphere from 0.02 per cent to 0.20 per cent was significant. No significance could be attached to the minor differences caused by variation in carbon-monoxide content up to 0.1 per cent by volume, nor



AVERAGE CORROSION OF TEST MATERIALS IN VARIOUS SYNTHETIC COMBUSTION ATMOSPHERES

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to the differences obtained by partial immersion of the specimens in an alkali-metal-salt mixture during the tests.

Thermal Shock and Other Comparison Tests of Austenitic and Ferritic Steels for Main Steam Piping—A Summary Report, by W. C. Stewart and W. G. Schreitz, U. S. Naval Engineering Experiment Station, Annapolis, Md. 1952 ASME Annual Meeting paper No. 52—A-35 (mimeographed).

IN this paper test results are summarized for thermal-shock specimens and mock-ups of ferritic and austenitic steels. In addition, complete test data are reported for a laboratory test program which was undertaken to supplement the full-scale tests. Thermal-shock tests of six-inch pipe and valve assemblies in both 18-8 Cb and 2¼ Cr, 1 Mo materials are described. Specimens were of two weights, schedules 80 and 160. The 160-schedule thermal-shock specimens each contained a section of dissimilar pipe which introduced transition and composite welded joints. The shock treatment was designed to simulate the quenching action that might result from the carryover of boiler water into a pipe line carrying steam at 1050 F temperature. The steam pressure for the 80-schedule specimens was 900 psi, and for the 160-schedule specimens, 2000 psi. Each assembly was subjected to 100 shocks.

Effect of mechanical loading on full-scale members was investigated by testing mock-ups which were designed to simulate expansion bends. A mock-up corresponding to each of the four thermal-shock specimens was tested. The mock-ups were formed by welding "S" bends to the connecting pipe and valve assemblies which were removed from the thermal-shock specimens. Each mock-up was subjected to 4000 deflections so adjusted as to induce a range of equivalent stress predicated on changing from a safety factor of 5 to 4. The test was repeated for the 80-schedule ferritic mock-up and the 160-schedule austenitic mock-up but for a range of induced stress based on changing from a safety factor of 5 to 3. Following this, the two mock-ups were subjected to a range of reversed bending stress to failure. The condition of the welds as affected by the thermal-shock treatment and the mock-up test is discussed.

The report contains considerable high-temperature test data that were obtained for laboratory specimens. The specimens were taken from pipe and casting assemblies which were fabricated and heat-treated in the same manner as the full-scale test members. Results include tensile properties to 1100 F, and stress-rupture, creep, and fatigue properties at 1000 and 1100 F temperatures. Tests were also made of specimens taken from thermal-shock specimens and mock-ups.

Resistance of Cast Fe-Cr-Ni Alloys to Corrosion in Oxidizing and Reducing Flue-Gas Atmospheres, by J. H. Jackson, C. J. Slunder, and O. H. Harder, Battelle Memorial Institute, Columbus, Ohio, and J. T. Gow, Electric Steel Foundry Company, Portland, Ore. 1952 ASME Annual Meeting paper No. 52—A-37 (mimeographed).

CORROSION of iron-chromium-nickel castings by sulphur-bearing gases at 1800–2000 F was investigated for the Alloy Casting Institute in a comprehensive series of tests. The sulphur was varied from 0 to 500 grains per 100 cu ft in both reducing and oxidizing flue gases. The effects of cyclic temperature fluctuations and alternately oxidizing and reducing atmosphere were also studied. Both metal loss and subsurface attack were considered in evaluating the alloys.

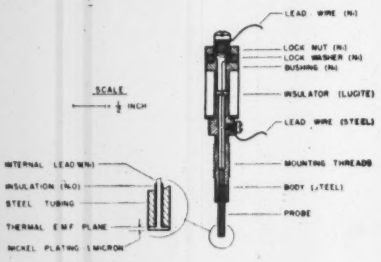
A wide range of composition of the ternary system Fe-Cr-Ni was studied with the chromium varying from 11 to 36 per cent and the nickel from 0 to 70 per cent. Although the behavior of the present commercially important alloys deviated in specific instances, it was shown that, in general, the HE (28 Cr, 9 Ni), HK (26 Cr, 20 Ni), and the HH (26 Cr, 12 Ni) type had the best resistance under a variety of test conditions. The HW (12 Cr, 60 Ni) alloy was generally better than the HT (15 Cr, 35 Ni) alloy and both performed well until the sulphur content of the gas was raised to 100 grains per 100 cu ft. The HX (17 Cr, 66 Ni) and HU (19 Cr, 29 Ni) alloys were generally better than the HW and HT types. However, they too were inferior to the HE, HK, and HH types when sulphur contents were 100 grains per cu ft or higher. The HF (20 Cr-10 Ni) alloy originally designed for temperatures below 1600 F performed reasonably well in the tests, and at 1800 F in reducing atmosphere containing at least 100 grains of sulphur per 100 cu ft, the alloy was slightly superior to the HW and HT types.

In general, the paper states, corrosion in the higher sulphur-bearing atmospheres was much less severe when the flue gas was oxidizing than when reducing.

Industrial Instruments

A Thermocouple for Measuring Transient Temperatures, by David Bendersky, Midwest Research Institute, Kansas City, Mo. 1952 ASME Annual Meeting Paper No. 52—A-57 (mimeographed).

THE need for an instrument to measure transient temperatures arises in numerous heat-transfer investigations. Because of their simplicity and comparatively rapid response, fine-wire thermocouples are usually employed. However, in certain applications fine-wire thermocouples are unsatisfactory because of their lack of strength, and difficulties in positioning the junction at the point of interest. Furthermore, the minimum size of the junction, which affects the rate of response, is usually limited to the wire diameter.



CROSS SECTION OF THERMOCOUPLE

(Hot junction thermal emf plane is at interface between nickel plating and steel tubing.)

A special thermocouple designed to measure temperatures within one micron of an exposed surface is described. It is particularly suited for use on metal surfaces which are subjected to rapid temperature changes. Details of construction, fabrication, installation, and characteristics of performance are presented.

The development of this thermocouple was undertaken, under the sponsorship of the Office, Chief of Ordnance (ORDTS), to provide a means for measuring gun-bore surface temperatures.

Optimum Three-Mode Controller Settings for Automatic Start-Up, by D. W. Pessen, Jun. ASME, Brown Instruments Division, Minneapolis-Honeywell Regulator Company, Philadelphia, Pa. 1952 ASME Annual Meeting paper No. 52—A-58 (mimeographed).

FOR some processes, a great number of different combinations of controller settings will produce acceptable automatic start-up performance without overshooting. For other processes, notably those containing a large amount of dead time.

the usable combinations of controller settings may be more difficult to find. This paper presents a formula giving the proper controller settings as functions of the ultimate natural period and the ultimate proportional band of the process control loop.

The formula fixes the value of reset rate and proportional band which should be used, and gives the approximate value of the rate time to be used as a first approximation. The controller settings specified by the formula produced not only good start-up performance, but also provide close to optimum recovery from process load disturbances. The use of the formula is therefore recommended even in the case of continuous processes where automatic start-up is not required. In discussing optimum controller response, a distinction has been made in this paper between the response to momentary and to sustained load changes.

Finally, the paper discusses the effect of dead time on start-up performance, and suggests a "rule of thumb" giving an indication of the maximum amount of dead time tolerable on automatic start-up.

Fluid Meters

The Venturi as a Meter for Gas-Solids Mixtures, by Leonard Farbar, Jun. ASME, University of California, Berkeley, Calif. 1952 ASME Annual Meeting paper No. **52—A-31** (mimeographed).

THIS paper undertakes the determination of the behavior of a Venturi tube when metering the solids phase in a gas-solids mixture for the condition of constant gravimetric gas flow rate.

The Venturi tubes were used in both a horizontal and vertical section of 17-mm-ID glass conduit and had throat diameters of 0.500 in. and 0.375 in. The gas-solids mixtures consisted of air and alumina-silica catalyst (an aggregate mixture containing a size range varying from 10 to 220 microns) with solids loadings as high as 10 lb of solids per lb of air. Results of four different gas flow rates indicated a linear relationship between the Venturi pressure differential and the solids flow rate over the range of loadings attainable with the experimental equipment. The linear relationship was observed for each Venturi size in both the horizontal and vertical location. The slope of these lines increased with increased air-flow rate and decreasing Venturi throat diameter. Pressure recovery in the diffuser section of the Venturi was observed and found to vary in nonlinear fashion with the solids rate.

According to the paper it appears that the Venturi may be used with satisfactory results in the metering of a solids phase in a gas-solids mixture when the gravimetric gas flow rate is held constant.

In plants and pilot plants handling powdered solids by pneumatic conveyance, the paper states, the Venturi may serve as a useful tool in indicating any instantaneous changes in the solids flow rate as well as the gas flow rate.

Experimental Evaluation of Expansion Factors for Steam, by J. W. Murdock, Mem. ASME, and C. J. Foltz, Jun. ASME, U. S. Naval Boiler and Turbine Laboratory, Philadelphia, Pa. 1952 ASME Annual Meeting paper No. **52—A-52** (mimeographed).

THE empirical expansion factor for the orifice metering of compressible fluids is based largely on tests of natural gas and air. This paper presents data on superheated steam for orifice ratios from 0.30 to 0.82, superheats from 29 to 255 F, and pressures of 44 to 102 psia. Expansion factors obtained were in close agreement with those of natural gas and air.

Tests described in this paper were conducted at the U. S. Naval Boiler and Turbine Laboratory as part of the cooperative program of the Joint AGA-ASME Committee on Orifice Research. Tests with steam and water were made to supplement those with natural gas at Rockville, Md. and Refugio, Texas, and others with water at the National Bureau of Standards.

Much of the data described were obtained during tests to determine interference effects of fittings placed various distances upstream on orifice. Additional runs were made to furnish more complete evaluation of the expansion factor.

Measurement of Pulsating Flow With Propeller and Turbine-Type Meters, by R. B. Dowdell, Jun. ASME, and A. H. Liddle, Jr., Builders-Providence, Inc., Providence, R. I. 1952 ASME Annual Meeting paper No. **52—A-32** (mimeographed).

TESTS were made on four different fluid meters under various conditions of unsteady flow. Results are presented, showing that in some cases accurate measurement of pulsating flow is possible.

It has been conclusively proved, both by theory and experiment, that it is possible to measure accurately pulsating flow with a differential-type flowmeter when pulsations are excessive. The suppression of pulsations in a pipe line, either by filters or surge tanks, is often unsatisfactory and may prove to be a large expense. Thus a meter which will accurately measure pulsating flow has long been desired.

This paper shows that with the magnitude and frequency of pulsations tested, a propeller-type flowmeter will accurately totalize the flow of an incompressible fluid. The shunt flowmeter, a device which combines some of the features of a differential-type meter and some of those of a propeller-type meter, though performing accurately under some conditions, may produce readings with considerable error when measuring a compressible pulsating flow.

Hydraulics

Pressure Surges at Large Pump Installations, by J. Parmakian, Mem. ASME, U. S. Bureau of Reclamation, Denver, Colo. 1952 ASME Annual Meeting paper No. **52—A-60** (mimeographed).

THIS paper describes the method of water-hammer analysis and control used in the design of the large pump installations at Grand Coulee, Granby, and Tracy Pumping Plants for the condition of power failure at the pump motors. It includes a summary of the major features of these installations and a comparison between the observed and computed water-hammer effects. Useful charts for obtaining the approximate water-hammer effects in any pump discharge line due to power failure are also presented.

It is concluded that pressure surges in pump discharge lines subsequent to a power failure at the pump motors can be computed accurately if the complete characteristics of the pump are known. In most cases only the characteristics for the zone of normal pump operation are obtainable from the pump performance data supplied by the pump manufacturer. This permits an accurate determination of the water-hammer effects up to the point at which the flow reverses through the pump. When necessary, pump characteristics for the zones of energy dissipation and turbine operation can be estimated with sufficient accuracy for water-hammer purposes.

Electromagnetic Pumps for High-Temperature Liquid Metal, by J. F. Cage, Jr., Knolls Atomic Power Laboratory, General Electric Company, Schenectady, N. Y. 1952 ASME Annual Meeting paper No. **52—A-66** (mimeographed).

IN THE development of means of converting atomic power into a more controllable and conventionally usable

form, a large effort has been devoted to the development of liquid metals as heat-transfer media. Because of certain requirements of liquid-metal systems, the development has included the investigation of a number of unusual means of pumping. One such means—the electromagnetic pump—has proved to be uniquely suited to the circulation of certain of the liquid metals. Its success in this field may help open the door to a more widespread use of liquid metals as heat-transfer fluids, and are therefore of general interest. The pumps themselves are of interest as usual pieces of equipment, having no seals or stuffing boxes and (at least in theory) no moving parts other than the fluid itself.

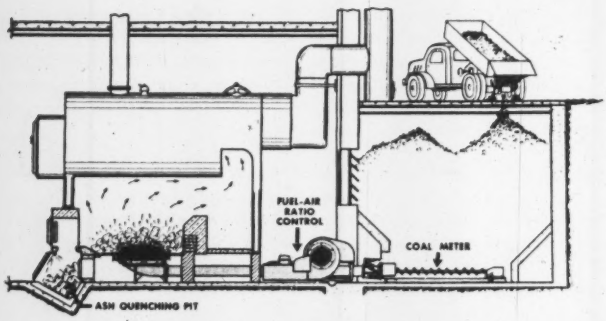
The particular requirements which caused the electromagnetic pump to be studied are these. First and foremost, it is required that pumps, to be usable in any radioactive liquid-metal system, be leakless—to a degree higher than that capable of achievement with any known conventional shaft seal. Second, it is necessary that pumps have a high degree of dependability such as might be obtained with a device having no moving parts to wear out. In addition, sodium and its potassium alloys (commonly called NaK) have been widely considered as suitable reactor coolants, and their properties make them unusually amenable to pumping by electromagnetic means. A number of different types of electromagnetic pumps have been studied and built as a part of the work in the field of liquid metals, both to supply the requirements of various heat-transfer experiments using sodium and NaK, and to obtain design information on electromagnetic pumps for possible future application to nuclear power plants using sodium and NaK as heat-transfer fluids.

This is a summary article describing some electromagnetic pumps for liquid metals. The design and performance characteristics of various types of electromagnetic pumps are described. The pumps vary in size and application for small-scale laboratory pumps to pumps suitable for circulating liquid metal in a nuclear-reactor power plant.

Fuels

Application and Performance of Single-Retort Underfeed Stokers, by E. C. Webb, Mem. ASME, and J. E. Atchinson, Iron Fireman Manufacturing Company, Cleveland, Ohio. 1952 ASME Annual Meeting paper No. **52—A-67** (mimeographed).

ACCORDING to the paper, the small single-retort underfeed stoker is the only commercial method of burning coal that provides satisfactory automatic operation on load cycles that include long banking periods or extended periods of very light load.



TYPICAL APPLICATION OF MODERN BIN-FEED STOKER

There are a great many small single-unit plants used primarily for space heating which have this type of load cycle and a better understanding of the operating characteristics of these units should be helpful to those responsible for specifying or purchasing combustion equipment for such plants.

The fundamental characteristic of the small underfeed stoker that permits this type of operation is its ability to maintain ignition over a relatively small portion of the grate area (that is, in the retort zone), then to automatically expand the active burning area to handle full firing rate. It is obviously impractical to reduce the heat release from a fuel bed to a very low banking rate and still maintain ignition temperature over a major portion of the grate area.

Even with the single-retort underfeed stoker which is particularly well-suited to this type of load, there are several very important considerations which should not be overlooked if high average combustion efficiencies and smokeless operation are to be obtained.

An analysis of the effect of plant load and other variables on the application and performance of underfeed stokers is given.

Consideration is also given to the elements of stoker construction and application methods best-suited for efficient automatic operation.

Industrial Experience in Fly-Ash Collection, by B. S. Norling, Mem. ASME, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. 1952 ASME Annual Meeting paper No. **52—A-69** (mimeographed).

UNTIL recent years, the atmosphere was considered a natural means of waste disposal. Almost without exception the furnace gases from homes, schools, small and large industries, alike, discharged their furnace gases with all the products of combustion into the atmosphere. With the increase in population and concentration of industry, this practice cannot be continued without deleterious effects. This paper discusses the problems involved, citing as an example the installation of fly-ash collectors and the disposal system for a large existing industrial plant.

It is pointed out that most of the present-day ordinances have been enacted as a result of local studies made following 1946. The need for fly-ash collectors was fully recognized by few industrial plants prior to World War II, but little could be done about it during the war. In a few cases provisions were made for a future installation. If the collectors are installed when the plant is built, the cost is but a fraction of the cost to install them later, particularly when no provisions are made for the future installation. The mechanical collector has, in general, been a lower-cost installation than the electrostatic precipitator and it has been used more widely in the industrial plants. It does not give the clean-up that is possible with the electrostatic precipitator. If the electrical characteristics of the ash are not suitable, the precipitator may also give a performance far below that expected. There seems to be a field for each type. At present, a combination of the two types appears to overcome many of the limitations. However, cost and space prohibit the use of the combination on most existing boiler plants. The higher-efficiency mechanical collectors limit the fly-ash emission rate sufficiently to meet nearly all of the existing ordinances except the A.P.S.-P.A.A. ordinance applied to large plants. It is to be expected that future ordinances will become more restrictive and the improvement in the application of collectors or any other means of reducing atmospheric contamination must be given careful study in considering future installations.

Heat Transfer

Heat-Transfer Measurements by the Method of Cyclic Temperature Variations, by R. E. Grimble and S. L. Fawcett, Columbus, Ohio. 1952 ASME Annual Meeting paper No. **52—A-68** (mimeographed).

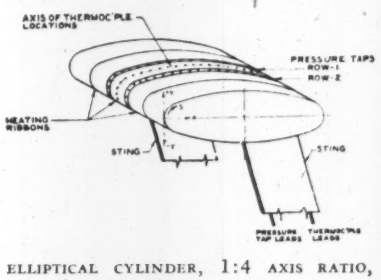
THE cyclic method of measuring convective-heat-transfer coefficients makes use of the fact that a fluid stream having a cyclically varying temperature undergoes a decrease in temperature amplitude and a corresponding lag in phase resulting from exchange of heat with the passage walls.

Equations governing the heat exchange have been solved for a sinusoidally varying temperature, relating the heat-transfer coefficient to the ratio of outlet to inlet-temperature amplitudes, together with other measurable properties of the system. The cyclic method has the important advantage of eliminating the very difficult measurement of surface temperatures.

Local Heat-Transfer Coefficients on the Surface of an Elliptical Cylinder, Axis Ratio 1:3, in a High-Speed Air Stream, by R. M. Drake, Jr., R. A. Seban, Jun. ASME, D. L. Doughty, Jun. ASME, and S. Levy, University of California, Berkeley, Calif. 1952 ASME Annual Meeting paper No. **52—A-59** (mimeographed).

LOCAL heat-transfer coefficients and thermal recovery factors from a 1:3 axis ratio elliptical cylinder to air are presented for angles of attack of +6, 0, and −6 deg with reference to the wind-tunnel center line. Air speeds ranged from 150 to 440 fps yielding Reynolds numbers based on the major axis of the cylinder of 4.34×10^5 to 1.28×10^6.

The heat transfer was measured experimentally for the primary purpose of providing results which would be a basis for a check of the approximate methods for predicting the heat transfer in the laminar-boundary-layer region. This check has been made for one method of prediction with satisfactory results for the various flow geometries.



ELLIPTICAL CYLINDER, 1:4 AXIS RATIO, SHOWING PRESSURE TAP AND SURFACE THERMOCOUPLE ARRANGEMENT

Lubrication

On the Solution of the Reynolds Equation for Slider-Bearing Lubrication—IV, Effect of Temperature on the Viscosity, by F. Osterle, Jun. ASME, A. Charnes, and E. Saibel, Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa. 1952 ASME Annual Meeting paper No. **52—A-24** (in type; to be published in Trans. ASME).

IN THIS paper the problem of the inclined-surface slider with film thickness varying exponentially is solved exactly considering the viscosity a function of both pressure and temperature. Side leakage is not considered in this solution. However, an approximate solution is presented which can be applied to the case in which side leakage is considered, as well as to the case in which side leakage is not considered. For the case of no side leakage this approximate solution is found to be quite accurate. For the finite-slider case, the approximate solution can be used with advantage as the first step in a relaxation, iteration, or successive approximations method of solution.

Using the methods developed, and starting from the more general equations, it is possible to take into account variations in the density of the lubricant, the paper states.

On the Solution of the Reynolds Equation for Slider-Bearing Lubrication V, The Sector Thrust Bearing, by A. Charnes, E. Saibel, Mem. ASME, and S. C. Ying, Carnegie Institute of Technology, Pittsburgh, Pa. 1952 ASME Annual Meeting paper No. **52—A-34** (mimeographed).

IN AN earlier paper the authors developed an exact solution of the Reynolds equation for the slider bearing when the film thickness varied in an exponential manner. It was shown that this solution could be used as an approximate solution for the plane inclined slider, with good accuracy. Furthermore the expressions for the pressure, total load, friction force, oil flow, and side leakage, and center of pressure were easily calculated from series which converged rapidly for all values of the parameter involved.

This paper attempts to develop a similar solution for the sector thrust bearing with side leakage for which no reasonably practical solution exists at the present time. For that reason recourse has been had in the past to analog solutions, numerical solutions, or approximations by means of analogous problems. In the numerical case any change in a dimension or parameter may necessitate a completely new solution, while in the others it is difficult to get good accuracy.

The solution developed in this paper results in, as before, rapidly convergent series and no trouble is experienced in applying the results to a sector thrust bearing having any values of the parameter.

On the Solution of the Reynolds Equation for Slider-Bearing Lubrication VI, the Parallel Surface Slider-Bearing Without Side Leakage, by F. Oesterle, Jun. ASME, A. Charnes, and E. Saibel, Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa. 1952 ASME Annual Meeting paper No. **52—A-33** (mimeographed).

TREATING the density of the lubricant as a function of temperature and the viscosity as a function of pressure and temperature, the problem of the parallel-surface slider bearing without side leakage is solved exactly in this paper for the case of adiabatic flow.

The theory permits rapid evaluation of the maximum film pressure, the point in the film where the maximum pressure occurs, the film temperature at this point, and the film temperature at outlet.

Experiments With Water-Lubricated Tapered-Land Thrust Bearings, by Maurice Levinsohn, and Nowland E. Reynolds, III, U. S. Naval Engineering Experiment Station, Annapolis, Md. 1952 ASME Annual Meeting paper No. **52—A-29** (mimeographed).

EXPERIMENTS were made to determine the load-carrying ability of water-lubricated, tapered-land, carbon thrust bearings. Nine different bearings having various combinations of radial and circumferential tapers were tested. As was expected, the degree of taper had a profound effect on performance of those bearings tested.

It was found that water-lubricated carbon-thrust bearings, with the correct amount of circumferential and radial taper, can successfully carry loads of at least 110 psi at speeds from 860 to 3450 rpm.

Radial tapers perform acceptably at high rotative speeds, according to the paper. At low speeds they may reduce the ultimate load capacity of the bearing.

Circumferential tapers of extremely slight angle appear to be associated with the greatest friction. Moderate tapers, B-2 and B-3, have low friction loss and

are most dependable at low speeds and high loads.

From the data on hand, a good all-round design for a water-lubricated $2^3/_4$ in. OD, $1^3/_4$ in. ID, fixed land, carbon thrust bearing would incorporate: (*a*) Six lubricant distributing grooves, (*b*) rounded or beveled leading edges on the six lands, (*c*) circumferential taper in $^2/_3$ or $^3/_4$ of the land area, 0.0006 in. to 0.0008 in. deep at the lowest point, (*d*) radial taper of zero to 0.0003 in. per in. sloping down toward the inner diameter, (*e*) untapered portion of the lands flat and smooth.

The Lubrication of Gyroscopes, by J. E. Brophy, Jun. ASME, and J. B. Romans, Naval Research Laboratory, Washington, D. C. 1952 ASME Annual Meeting paper No. 52—A-51 (mimeographed).

THE lubrication requirements of a number of gyroscopes have been studied as a prerequisite to the development of improved rotor-bearing lubricants and with the additional objective of replacing of proprietary lubricants by one or more lubricants to be specified in the future.

The gyroscopes studied included both air-driven and electrically driven types. Measurements were made of bearing temperatures, rotor speed, rate of deceleration, power input, and bearing noise level, the noise components being analyzed.

A small high-speed evacuated gyro failed by the time 650 hr of operation had been reached, the paper states. The other gyros studied all operated without bearing failure for a minimum of 10,000 hr on the specified lubricants. Two electric gyros have operated satisfactorily for 10,000 hr on synthetic diester-type lubricants.

Gyro repair facilities reported that the paramount problem in overhaul work was that of obtaining suitable replacement bearings. It has become evident that causes of abnormally short rotor-bearing life include the use of inferior replacement bearings, poor overhaul techniques, and careless handling of equipment. Some of the proprietary lubricants are not suitable for use in instruments which are in storage for long periods.

Contribution to the Theory of Oil Whip, by H. Poritsky, Mem. ASME, General Electric Company, Schenectady, N. Y. 1952 ASME Annual Meeting paper No. 52—A-64 (mimeographed).

IN this paper it is shown that an explanation of oil-whip phenomena, at least for small eccentricities, can be obtained from the equations of hydrodynamic forces and the dynamical equations of motion, provided that the hydrodynamic-force expressions be modified to delete from the oil forces the hitherto included contributions from the regions of negative pressure. While the exact determination of the oil flow and oil forces including this correction would be difficult to carry out at present, the approximate manner indicated in this paper gives a satisfactory account of oil-whip phenomena for small eccentricities: there is added a force component in the radial direction, linear in the radial displacement, and with a proper "stiffness constant."

Metal-Cutting Data

Metal-Cutting Chatter and Its Elimination, by Robert S. Hahn, Mem. ASME, The Heald Machine Company, Worcester, Mass. 1952 ASME Annual Meeting paper No. 52—A-41 (mimeographed).

THIS paper outlines some of the facts about metal-cutting chatter, tells how to eliminate it, and considers some of the fundamental causes of chatter.

The practical problem of suppressing chatter in a machine tool can often be solved by a study of the modes of vibration and the proper application of dampers, the paper states.

Concerning the cause of chatter, three phenomena may be recognized, namely, primary chatter, transitional instability, and feedback effect.

Primary chatter is believed to be caused by the lag of the temperature and stress state in the vicinity of the shear plane.

Transitional instability is associated with a work-hardened skin and may occur whenever all or part of the cutting edge operates in this region.

Constructive and destructive feedback effects are demonstrated and a method of utilizing these effects to suppress chatter is suggested.

A Standard of Procedure for Evaluating the Tool Life of Single-Point Sintered-Carbide Tools, by Technical Committee No. 21 on Tool Life Tests of Single-Point Tools and ASA Sectional Committee on Small Tools and Machine Tool Elements, B5. 1952 ASME Annual Meeting paper No. 52—A-39 (mimeographed).

SINTERED-CARBIDE tools have characteristics which require a correct grade and shape for each application, according to the paper. These grades, shapes, and cutting conditions for best practice are given in the catalogs of various manufacturers. Different grades will wear on a given job in a manner peculiar to the cutting conditions, including the material cut, size and shape of cut, and the cutting speed.

The test procedure for determining tool life is quite similar to that given for tools of high-speed steel and cast nonferrous metal. Carbide tools are not run to complete tool breakdown, however, as too much of the carbide would have to be ground away in resharpening, or at complete failure the tool would crack and destroy most of the carbide metal.

In running any tool-life tests, the paper states, all elements except the one being tested should be kept constant. For example, if the relative machinability of several steels is to be determined, then the cutting-tool material, the tool shape and size, the grinding, as to tool form and surface quality, the depth of cut and feed, the setting angle of the tool, and application of the cutting fluid should be kept constant while a tool-wear test for one, or for each of several speeds, is run on each steel. The time to produce the same wear on a tool by each steel is then compared. The objective is to obtain results which are comparable in the life tests so all factors must be carefully controlled.

A Lathe Test for the Evaluation of Cutting Fluids, by J. D. Oathout, W. L. Howell, Jr., J. P. Hamer, and H. L. Leland, Standard Oil Development Company, Esso Laboratories, Linden, N. J. 1952 ASME Annual Meeting paper No. 52—A-49 (mimeographed).

WITH the growth of research in metal cutting, manufacturers of cutting fluids are becoming increasingly aware of the need for practical laboratory performance tests to aid in the development of improved fluids. The development of metal-cutting theory, advances in metals and tool alloys, and improvements in machinery and production are rapidly outmoding trial-and-error methods for selecting and improving cutting fluids. The usual laboratory lubricant test methods, none of which involve cutting, have seldom been satisfactory for cutting-fluid evaluation. Wear, friction, or load-carrying tests have been used because nothing else was available. The single properties usually measured by such tests are difficult to correlate with the total activity of a fluid as a coolant and lubricant when it is applied to a cutting

operation. Metal cutting is a complex process involving shear, deformation, and friction and is difficult, if not impossible, to simulate in known bench scale tests.

This paper describes a procedure that was developed to overcome these shortcomings by evaluating cutting fluids with full-scale equipment in an actual cutting operation. It consists of measuring the effects of a fluid on tool life during single-point turning of steel. Single-point turning was selected for cutting-fluid evaluation as a representative and standard shop operation with which performance data can be obtained readily in short-run tests. Practically every cutting operation, whether milling, grinding, broaching, turning, or tapping, may be considered at any one point of metal removal as a single-point process. Moreover, while many shop operations may be other than single point, the inclusion of multipoint or complex tools in a test of this type may introduce tool performance variables greater than the variations due to the cutting fluids.

Techniques of the procedure described in the paper are the result of many trials covering a wide range of testing conditions. The test has proved to be a reliable means of selecting superior cutting-fluid compositions and for determining the optimum concentrations and the practical effects of various additives. New or unusual cutting-fluid compositions can be tried out and their benefits determined without the necessity of speculating on unrelated laboratory data. The reliability of the lathe test as a measure of practical cutting-fluid performance has been established through numerous field tests under widely varying cutting conditions.

Power Required by Carbide-Tipped Face-Milling Cutters, by W. W. Gilbert, Mem. ASME, and O. W. Boston, Fellow ASME, University of Michigan, Ann Arbor, Mich., and H. J. Siekmann, General Electric Company, Detroit, Mich. 1952 ASME Annual Meeting paper No. **52—A-53** (mimeographed).

DURING the years 1944, 1945, and 1946 a great amount of data on the power required to face-mill under various cutting conditions was developed from two extensive research projects. The average effect of cutting variables on horsepower was derived after the data had been tabulated and correlated. These data are presented in a form useful for determining the best setup and the power required for a given cut, or the conditions of the cut which will utilize the horsepower capacity of a milling machine. At a time when machine tools are at a premium, operating them at their full capacity is essential if production schedules are to be met.

The research projects to obtain fundamental data on high-speed milling were established at the California Institute of Technology and the University of Michigan by the War Production Board through its Office of Production Research and Development, and the Manufacturing Engineering Committee of the ASME during 1944–1946. Some results of these tests were distributed to industry on Data Sheets published by ASME.

This paper presents the data dealing with the power requirements as influenced by the setup conditions when face-milling with sintered-carbide tools. A second paper will show the influence of cutter design on power requirements, and a third and fourth paper of this series will deal with the tool life of face-milling cutters with sintered-carbide teeth operating under various conditions of speed, feed, depth of cut, cutter size and shape, and in a number of irons and steels.

Mechanically Mounted Cutting Elements of Cemented Carbide, by W. L. Kennicott, Mem. ASME, Kennametal Incorporated, Latrobe, Pa. 1952 ASME Annual Meeting paper No. **52—A-62** (mimeographed).

AT the 1944 ASME Annual Meeting, a paper was presented by the author, dealing with the development and application of tool designs for mechanically mounting carbide cutting blades or bits for metal cutting. Tool designs and application technique have changed considerably since that time, and this paper presents an up-to-date picture of carbide-tool-design practices as compared with the relatively crude and cumbersome designs presented eight years ago.

Cutting-tool design should be based on three principal factors, the paper states: First, the tool shape must be such that it will fit into the machine tool and perform the cutting operation involved. Second, the tool mechanism or construction should be based upon the physical and mechanical properties of the cutting element. Third, the composite assembly must be durable enough to stand operating conditions for an extended period of time, and as simple as possible to maintain. The first and last of these are generally recognized, but the properties of the cutting material are often ignored, and one type of cutting material substituted for another without changing the basic tool design.

The biggest advance in carbide tooling during recent years has been the recognition that any material has some physical and mechanical properties which are potential assets, and some which are potential liabilities. Only by careful consideration of these properties in designing can we hope to get the best possible performance from the material. In the case of hard carbide cutting tools, remarkable improvement in performance and broadening of the field of application has resulted from improved tool design based upon laboratory determined properties, the paper states.

Grinding and Lapping Stresses in Manganese Oil-Hardening Tool Steel, by Harold R. Letner and Harold Jack Snyder, Mellon Institute of Industrial Research, Pittsburgh, Pa. 1952 ASME Annual Meeting paper No. **52—A-38** (mimeographed).

In this paper the biaxial stress distributions resulting from grinding and lapping annealed manganese oil-hardening tool steel were determined by sectioning the stressed surface layers and following the changes in curvature of the test specimens by optical interferometry. Two methods of sectioning, lapping, and chemical etching were tested and evaluated.

Results show that the plastic deformation which gives rise to the residual stress is at least partially due to mechanical forces exerted upon the surface by the abrasive grains and cannot be explained by forces of thermal origin alone. Grinding stresses were found to fluctuate rapidly close to the surface, the highest stresses being confined to a surface layer about 0.0001 in. thick. Depth of stress penetration increased with depth of cut over the range tested. Lapping stresses were found to have a nearly constant compressive value throughout the surface layer affected which, for the conditions investigated, was about 0.0002 in. thick.

Machine Design

Design of Servo Gear Trains to Minimize Reflected Inertia, by Paul Brook, New York, N. Y. 1952 ASME Annual Meeting paper No. **52—A-48** (mimeographed).

A GENERALIZED method of minimizing reflected inertia of a servo gear train and a discussion of the application is presented in this paper. Two nomographs based on a simplification of the general case are included. These enable the designer to choose an optimum number of meshes in a train of given over-all ratio and to choose the ratio of the individual meshes so as to minimize the inertia reflected by the gear train into the motor.

The method is applicable primarily with instrument servos where the gear-train inertia represents an appreciable portion of the load.

The Motion of a Link Chain Over a Roller, by A. E. Richard de Jonge, Mem. ASME, New York, N. Y. 1952 ASME Annual Meeting paper No. 52—A-55 (mimeographed).

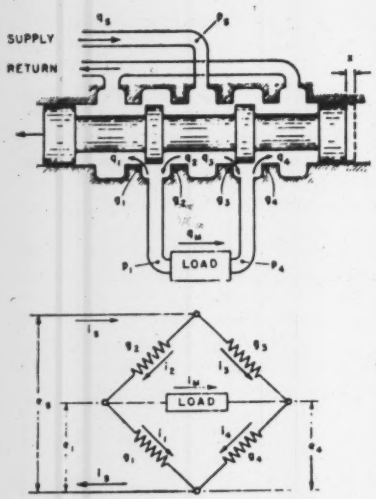
A COAL-CUTTING excavator is described in this paper in which trouble was encountered with link chains carrying excavating buckets. The chains were moved by an upper hexagon tumbler driven by an electric motor. The trouble was traced to the link chains passing over too small a deflecting roller.

An investigation into the geometry of the problem is presented and it is shown that the mechanical three or multibody problem can be reduced to a problem in kinematic geometry by eliminating the forces, but retaining their lines of action. A solution for this problem is given. The principal object, namely, the derivation of the correct dimension for the deflecting roller to prevent the troublesome condition that existed, has been solved.

Contributions to Hydraulic Control, Pressure-Flow Relationships for a Four-Way Valve, by J. F. Blackburn, Massachusetts Institute of Technology, Cambridge, Mass. 1952 ASME Annual Meeting paper No. 52—A-42 (mimeographed).

WHEN the Dynamic Analysis and Control Laboratory (D.A.C.L.) began work on flow-valve servos, one urgent need was the creation of a medium of communication between the hydraulics engineers and the servo designers. The specific task was to find out which hydraulic characteristics of the valve were of importance from the servo standpoint, and to set up a method whereby the servo designer could specify quantitatively what kind of a valve the hydraulics engineer should supply. The first solution of the problem at the D.A.C.L. was given in an internal memorandum in which the equivalent circuit and the transfer function of the four-way valve on the basis of certain linearizing assumptions was worked out. These assumptions were contrary to fact, just as the assumption of the linearity of a vacuum tube when operated as a class-A amplifier is contrary to fact, but as in the case of the vacuum tube, the theory based upon such an obviously insufficient foundation has worked and worked well.

In this paper the characteristics of several types of four-way flow-control



SCHEMATIC DIAGRAM OF FOUR-WAY VALVE

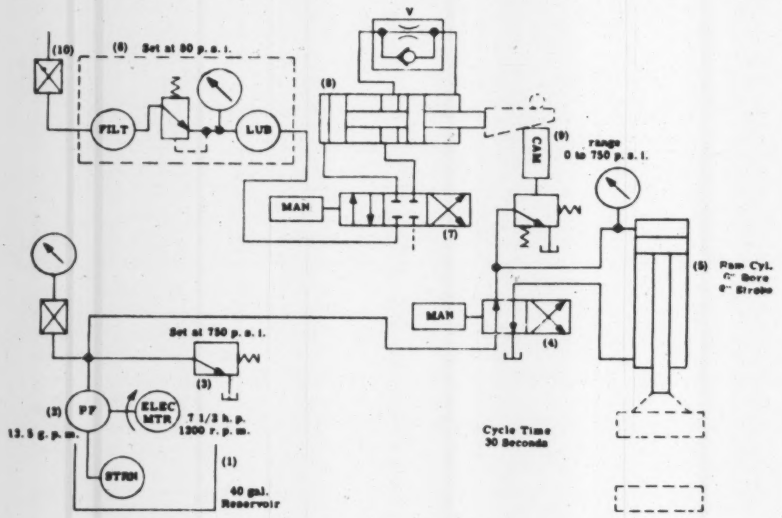
valves are derived without making linearizing assumptions. These characteristics are plotted as load flow vs load pressure, in a manner analogous to the plate characteristics of a vacuum tube. Several differential coefficients are derived and tabulated, and the valves are compared from the standpoint of linearity, sensitivity, power output, and losses.

Multiple Pressures in a Single Hydraulic Circuit, by Harry L. Stewart, Logansport Machine Company, Inc., Logansport, Ind. 1952 ASME Annual Meeting paper No. 52—A-46 (mimeographed).

THIS paper points out the many advantages that can be gained in using multiple-pressure hydraulic systems for press applications, testing devices, and the like. It also points out some of the difficulties that might be encountered if the proper system is not selected.

With the number of applications for hydraulic equipment skyrocketing every year, pressures now required to perform the most satisfactory work in any circuit may vary greatly in different parts of that circuit. Of course this will depend largely on the work to be done and the complexity of the installation. A good example of this is on large automatic machines where the workpiece is clamped by a lightweight hydraulic cylinder and the work performed must be done by a high-pressure hydraulic cylinder. If both cylinders were to be operated at the same pressure, the clamping cylinder would be impractically small or the work cylinder must be of a diameter that would be too bulky to fit into the installation. Also, the volume of oil supplied to a very large hydraulic cylinder may be impractical. In order to eliminate such operating conditions and make the installation as compact as possible, part of the system operating at one pressure and another part at another pressure is ideal. By using a multiple-pressure system, heat, wear, and leakage may be reduced to a minimum and better service life may be expected from valves, cylinders, and power units.

Many methods may be employed to obtain two or more working pressures from a single circuit. This paper discusses several successful methods now being used. These methods include pressure-reducing valves, individual high- and low-pressure pumps, combination pumps with changeover valves, cam-operated relief valves, and pressure intensifiers.



HYDRAULIC CIRCUIT WITH ADJUSTABLE HYDRAULIC PRESSURE

Contributions to Hydraulic Control, Lateral Forces on Hydraulic Pistons, by J. F. Blackburn, Massachusetts Institute of Technology, Cambridge, Mass. 1952 ASME Annual Meeting paper No. 52—A-44 (mimeographed).

STICKING or excessive friction of pistons or valves in their bores has always caused trouble to designers and users of hydraulic equipment. The phenomena involved are complex and incompletely understood. This paper shows that large lateral forces may be caused by hydrodynamic phenomena alone, without the complicating effects of dirt in the oil. It presents expressions describing the lateral force for certain cases of simple geometry, with experimental verification, and discusses other cases qualitatively. Finally, it summarizes briefly present ideas concerning the frictional phenomena involved and lists several questions to which the answers must be obtained by further investigation.

Contributions to Hydraulic Control, by J. F. Blackburn, Massachusetts Institute of Technology, Cambridge, Mass. 1952 ASME Annual Meeting paper No. 52—A-43 (mimeographed).

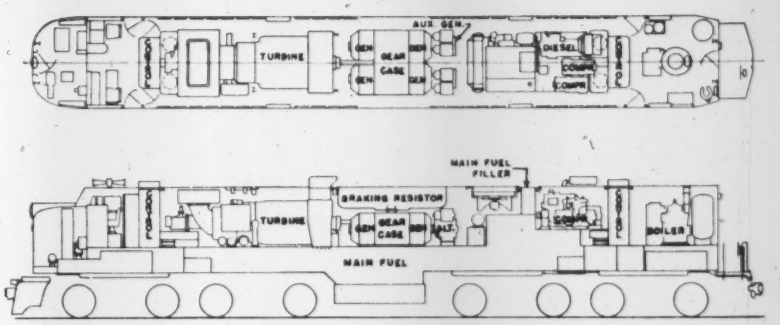
SEVERAL devices based on the hydraulic analog of the Wheatstone bridge are discussed in this paper. These include bridges and derived configurations for which flow is proportional to pressure but independent of the viscosity of the liquid used, fluid sources with linear output resistances, and a bridge for the direct measurement of hydraulic conductance.

Railroads

Gas-Turbine Electric Locomotives on the Union Pacific Railroad, by A. H. Morey, Mem. ASME, General Electric Company, Erie, Pa., and F. Fahland, Union Pacific Railroad, Omaha, Neb. ASME Annual Meeting paper No. 52—A-56 (mimeographed).

TESTING operation of the first gas-turbine electric locomotive built by General Electric Company covered 21 months of operation in which 348,608,000 gross ton-miles of freight were handled. In this paper comments are made on grade performance, riding qualities, crew acceptance, and servicing. The major differences between the first and the ten succeeding locomotives ordered in 1951 by the Union Pacific Railroad are outlined.

A brief description of the locomotives furnished, together with operating results to date, are presented with discussion of train handling and equipment operation. Service operations are described and the various troubles encountered are briefly discussed. Data are presented on locomotive characteristics and performance.



GENERAL LAYOUT OF APPARATUS IN THE PRODUCTION GAS-TURBINE LOCOMOTIVE CAB

A Method for Determining Stresses and Vibration Data in Brake Beams Under Actual Operating Conditions, by Robert B. Cottrell, Sr., Mem. ASME, American Steel Foundries, Chicago, Ill. 1952 ASME Annual Meeting paper No. 52—A-11 (mimeographed).

ACCORDING to road test data, it was revealed that speed had little if any effect on brake-beam stresses. A survey of traces of SR-4 strain-gage readings taken at speeds of 20 through 80 mph indicated that speed had no appreciable effect on brake-beam stresses. This was so evident that the bulk of the analysis given in this paper was carried out independently of speed.

Studies showed no serious vibration frequencies in the beams unless a braking load was applied to them. In other words, with the car running free with no brake application the vibration pattern was minor regardless of speed.

The recordings showed that the highest stresses in the brake beams occurred during brake application. While not strictly linear, the amount of stress was generally proportionate to the brake cylinder pressure. Such stresses, of course, were augmented in certain instances due to impacts which occurred at road crossings, rail joints, crossovers, and other track irregularities.

Wheel rotation had an appreciable effect on beam stresses according to the paper. The forces on the beam due to friction between the brake shoe and the revolving wheel result in an augment. This augment was additive or subtractive, depending upon the location of the beam in the trucks and the direction of rotation.

Maximum stresses were produced in the beam in the "dead lever" position of the truck. This beam consistently showed not only the highest stress, but also higher over-all stresses than those in the other or "live lever" location.

The design of the structure had an effect on stresses and stress pattern. The general over-all picture was similar to that of the modern truck side frame, but varied somewhat between designs.

In general, according to the paper, higher average stress patterns were noted under loaded-car conditions than under light-car conditions. This, of course, is obvious inasmuch as for proper train control, heavier cars require heavier brake applications to stop a train within desirable stopping distances.

Results of this investigation of stress and vibration-frequency phenomena, under actual service conditions, have been very gratifying and extremely valuable to the designer. Heretofore the design of brake beams has been more or less along the line of theoretical analysis of a simple structure acted upon by a single load in a single plane.

Oil and Gas Power

Diesel Maintenance Control by Spectrographic Means, by H. K. Sennstrom, Mem. ASME, American Locomotive Company, Schenectady, N. Y. 1952 ASME Annual Meeting paper No. 52—A-61 (mimeographed).

A NUMBER of publications in recent years have described the excellent results obtained through spectroscopic analysis of Diesel lubricating oils in controlling Diesel-engine maintenance. Avoidance of serious engine failures, longer life of component parts, and more economical locomotive operation have resulted from the work of various in-

vestigators in a new application of this scientific tool. The American Locomotive Company has been collaborating with 18 railroad companies in extending this new technique in a broad-scale evaluation program. The ultimate results of the program appear most promising.

This paper outlines the over-all evaluation program, describes laboratory equipment and technique, collection and interpretation of field data, and typical test results. That there is a definite place for the spectrograph in the maintenance of Diesel locomotives is shown to be a justifiable conclusion on the basis of experience gained thus far.

Combustion of a Low-Volatility Fuel in a Turbojet Combustion Chamber—Effects of Fuel Vaporization, by V. V. Holmes, Jun. ASME, Douglas Aircraft Company, Santa Monica, Calif., A. J. Pahnke, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del., O. A. Uyehara, Jun. ASME, and P. S. Myers, Mem. ASME, University of Wisconsin, Madison, Wis. 1952 ASME Annual Meeting paper No. **52—A-50** (mimeographed).

THE influence of fuel vaporization on the combustion of mixtures of liquid hydrocarbons, particularly those of low volatility, has been of considerable interest and the subject of much speculation and study. Investigators in the Diesel combustion field have studied the vaporization problem theoretically, preheated the fuel, photographed the disappearance of the silhouetted fuel spray in a motored engine and its reappearance later in the cycle, and observed the pressure decrease due to vaporization cooling in operating engines and in combustion bombs. Although it has been generally concluded that in the Diesel engine vaporization takes place quite rapidly and is a secondary factor in the time delay between injection and ignition of the fuel, an appreciable decrease in the ignition delay is obtained when the fuel is preheated.

In this paper various degrees of vaporization of a typical Diesel fuel were obtained by varying the temperature of the oil supplied to the turbojet combustion chamber. Experimental data showing the effect of fuel vaporization on combustion efficiency, flame length, and flame temperature, are presented as well as flame temperature-distance data for the combustion chamber.

Diesel Lubricated-Oil Performance as Related to the Electron Microscope, by Ray McBrian, Denver & Rio Grande Western Railroad Company, Denver, Colo. 1952 ASME Annual Meeting paper No. **52—A-40** (mimeographed).

THE electron microscope, the paper states, can and should be used to control all received shipments of additive-type oils as to the maintaining of a normal additive pattern dispersity. Any unusual variation should result in a re-evaluation of the oil so as to prevent engine failures.

It was found that minute residual amounts of such impurities as fatty acids, sodium, magnesium, and oxidizing agents change additive structure and completely revert a good engine operation to a very poor operation with excessive wear, deposits, or corrosion conditions.

It was discovered as with the spectrograph that a scientific instrument used largely for research can be used practically and will give basic knowledge of engine conditions.

Previous conceptions as to what a satisfactory Diesel-engine lubricating oil should be is changing as knowledge and studies are increased in this field of colloidal and physical chemistry. Then, with the background of "letting the engine tell what is occurring," many of the apparently misunderstood happenings with lubricating oils will be solved, the paper indicates.

The mixing of various types of additive oils may result in very serious problems, and a much greater understanding of basic fundamentals is needed toward which the use of the electron microscope, in its infancy, is pointing the way.

Applied Mechanics

The End Problem of Rectangular Strips, by G. Horvay, General Electric Company, Schenectady, N. Y. 1952 ASME Annual Meeting paper No. **52—A-2**(in type; to be published in the *Journal of Applied Mechanics*).

J. FADLE was first to derive a solution for the stresses in a rectangular strip subjected on one of its narrow edges to a self-equilibrating system of stresses, i.e., stresses which have zero resultant force and zero resultant moment. Fadle's solution is rather unwieldy because of the use of complex (biharmonic) eigenfunctions. These eigenfunctions are associated with the roots of the equation $\sin 2\gamma \pm 2\gamma = 0$. The first (nonvanishing) root, as determined to seven decimals by Mittelman and Hillman, is $\gamma_2 = 2.1061961 + 1.1253643i$. In this paper we derive a variational solution of the same problem in the form $\varphi(x, y) = \Sigma c_n \varphi_n$ where, in first approximation, $\varphi_n = f_n(y)g_n(x)$. The series $\Sigma c_n f_n(y)$ is obtained by expansion of the boundary values $\varphi(0,y)$ of the Airy function φ into a complete set of self-equilibrating orthogonal polynomials $f_n(y)$; the functions $g_n(x)$ are then determined from the Euler-Lagrange equations of the associated variational problem. This procedure has the advantage of staying entirely in the real domain. The first approximation corresponds to the physical concept that the longitudinal fibers of the strip are beams on elastic foundation (the adjacent fibers furnish the elastic foundation) subjected to end thrusts and lateral loads. Incidental to this idea there are provided quantitative formulas which relate depth of penetration of an applied traction to its shape (number of its wiggles). The eigenvalues γ_n, the real parts of which furnish the extinction coefficients, are obtained from a quadratic equation in γ^2. One finds that the lowest (nonvanishing) eigenvalue is $\gamma_2 = 2.075 + 1.143i$. In higher approximations coupling effects between derivatives of the orthogonal modes $f_n g_n$ are also taken into account. The jth approximation to a mode φ_n is obtained by evaluating a $2j$—1-rowed determinantal equation involving the functions $f_{n-j+1}\ g_{n-j+1}$ to $f_{n+j-1}\ g_{n+j-1}$. High modes are calculated with the same facility and accuracy as is the fundamental except that the fundamental mode φ_2, not being preceded by other modes, requires, in jth approximation, only a j-rowed determinantal equation. One thus finds that in third approximation γ_2 is the root of a 6th degree equation in γ^2, and has the value $\gamma_2 = 2.1061964 + 1.1253644i$.

Water-Channel Analog to High-Velocity Combustion, by A. K. Oppenheim, Mem. ASME, University of California, Berkeley, Calif. 1952 ASME Annual Meeting paper No. **52—A-3** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper is a sequel to one presented in 1951 by the author. It was shown that during the development of detonation, the combustion zone which appears first in a unidimensional flow field as a single discontinuity, is later transformed into an unsteady, double discontinuity system, and it was demonstrated that such a transformation is necessary because of the restrictions imposed on the system by the dynamic boundary conditions. In the water channel the combustion-front discontinuity is simulated by a unidimensional source formed by ad-

mitting water from the bottom. By a proper selection of state parameters analogous relationships are derived to those between pressure and specific volume in a gaseous combustion system. Thus the consequences of restrictions imposed by dynamic boundary conditions on the propagation of combustion are illustrated in an analogous system which, being simpler in nature, is easier to understand. Moreover, the water-channel analog is utilized as an illustrative model of a system where controlled, stationary detonation could be achieved.

On a General Method of Solving Second-Order Ordinary Differential Equations by Phase-Plane Displacements, by L. S. Jacobsen, Mem. ASME, Stanford University, Stanford, Calif. 1952 ASME Annual Meeting paper No. **52—A-1** (in type; to be published in the *Journal of Applied Mechanics*).

THE phase-plane-delta method of solving second-order differential equations has been illustrated by numerous examples involving graphical constructions. Test cases show good accuracy for practicable size of steps, but, in general, the degree of approximation can be inferred empirically only. The delta method is extremely simple to apply, even to complicated equations. A subprofessional assistant can be instructed quickly in how to use the method, and ordinarily will develop enough speed to become useful in a short time.

On Turbulent Flow Between Parallel Plates, by S. I. Pai, University of Maryland, College Park, Md. 1952 ASME Annual Meeting paper No. **52—A-5** (in type; to be published in the *Journal of Applied Mechanics*).

THE Reynolds equations of motion of turbulent flow of incompressible fluid have been studied for turbulent flow between parallel plates. The number of these equations is finally reduced to two. One of these consists of mean velocity and correlation between transverse and longitudinal turbulent-velocity fluctuations $\overline{u_1'u_2'}$ only. The other consists of the mean pressure and transverse turbulent-velocity intensity. Some conclusions about the mean pressure distribution and turbulent fluctuations are drawn. These equations are applied to two special cases: One is Poiseuille flow in which both plates are at rest and the other is Couette flow in which one plate is at rest and the other is moving with constant velocity. The mean velocity distribution and the correlation $\overline{u_1'u_2'}$ can be expressed in a form of polynomial of the co-ordinate in the direction perpendicular to the plates, with the ratio of shearing stress on the plate to that of the corresponding laminar flow of the same maximum velocity as a parameter. These expressions hold true all the way across the plates, i.e., both the turbulent region and viscous layer including the laminar sublayer. These expressions for Poiseuille flow have been checked with experimental data of Laufer fairly well. It also shows that the logarithmic mean velocity distribution is not a rigorous solution of Reynolds equations.

The Bending of a Wedge-Shaped Plate, by S. Woinowsky-Krieger, Laval University, Quebec City, Quebec, Canada. 1952 ASME Annual Meeting paper No. **52—A-6** (in type; to be published in the *Journal of Applied Mechanics*).

A GENERAL method of solution is given in this paper for the problem of bending of a wedge-shaped thin elastic plate with arbitrary boundary conditions on the radial edges in the case of a single load. The solution is carried out for a plate with clamped edges and a single load on the bisector radius of the plate. Stress distribution along the edges is shown and the behavior of the solution near the corner point is discussed for several opening angles of the plate.

Nonlinear Distribution of Bending Stresses Due to Distortion of the Cross Section, by H. H. Bleich, Columbia University, New York, N. Y. 1952 ASME Annual Meeting paper No. **52—A-7** (in type; to be published in the *Journal of Applied Mechanics*).

A THEORY is presented to explain the nonlinear distribution of bending stresses found in recent tests on a passenger ship with long superstructure and in model tests. The hull and the superstructure are considered as separate beams which are forced to act together by shearing forces and by vertical forces resisting relative displacements of the two beams. The case of constant cross section of the beams is treated, and solutions in qualitative agreement with the tests are obtained for two types of loading.

Some Problems of Orthotropic Plane Stress, by H. D. Conway, Jun. ASME, Cornell University, Ithaca, N. Y. 1952 ASME Annual Meeting paper No. **52—A-4** (in type; to be published in the *Journal of Applied Mechanics*).

MANY plane-stress problems in isotropic elasticity are solved conveniently by considering the Airy stress functions in the form of Fourier series (periodic loading) or Fourier integrals (nonperiodic loading) of harmonic and biharmonic functions. The object of this paper is to show how many of these solutions can be extended to the case where the material is orthotropic. For illustrative purposes, the following seven problems are solved: (*a*) Half plane subjected to normal loading; (*b*) wedge subjected to axial loading; (*c*) half plane subjected to a normal force applied through a rigid punch; (*d*) half plane subjected to tangential loading; (*e*) wedge subjected to transverse loading; (*f*) force applied at a point in an infinite plane; and (*g*) analysis of deep beams.

Effect of Damping Constants and Stress Distribution on the Resonance Response of Members, by B. J. Lazan, Mem. ASME, University of Minnesota, Minneapolis, Minn. 1952 ASME Annual Meeting paper No. **52—A-8** (in type; to be published in the *Journal of Applied Mechanics*).

THE amplitude of vibration of a member at resonance, as defined by its resonance amplification factor, is analyzed in relationship to the damping properties of materials. Data are presented on damping energy to indicate the effect of stress magnitude, stress history, and temperature. Based on the mathematical relationship found to exist between damping and stress magnitude the resonance amplification factors are determined for a variety of direct stress members and beams. It is shown that the amplification in vibration caused by resonance may be considered to be the product of three basic factors, i.e., (*a*) the material factor, (*b*) the cross-sectional shape factor, and (*c*) the longitudinal stress-distribution factor. The first of these factors may be calculated from the damping and dynamic modulus properties of the material and the last two from the shape and loading characteristics of the member. Diagrams are presented to show these basic factors as functions of the damping exponent and other variables for members commonly encountered in engineering practice. Experimental data are presented to confirm the equations derived for resonance amplification factor of members having various shapes and stress distribution.

Elastic Waves Created During Tensile Fracture, by Julius Miklowitz, Naval Ordnance Test Station, Pasadena, Calif. 1952 ASME Annual Meeting paper No. **52—A-10** (in type; to be published in the *Journal of Applied Mechanics*).

IN SOME tensile tests with brittle materials, it was noted that fractures were produced at two different cross sections of the specimen when the rupture load was reached. The phenomenon of

the second fracture prompted the present investigation. It is believed that the second fracture is caused by the destructive action of the elastic strain waves created during the first of the two fractures. The analytical and experimental work carried out was focused on describing the character of these waves. Consideration of the mechanics involved reduces the problem to that of a vibrating cantilever beam with time-dependent boundary conditions. Two types of waves are shown to exist. The first is a longitudinal unloading wave (compression). The other is a group of flexural strain waves caused by the moment that develops at the initial fracture section. The methods of operational mathematics and the electric analog computer have been employed in the analytical study.

The Necking and the Rupture of Rods Subjected to Constant Tensile Loads, by N. J. Hoff, Mem. ASME, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. 1952 ASME Annual Meeting paper No. **52—A-12** (in type; to be published in the *Journal of Applied Mechanics*).

A ONE-DIMENSIONAL theory of the behavior of a nonlinear viscoelastic bar subjected to a constant tensile load is developed with the aid of a creep law considering secondary creep alone. The theoretical value of the time at which the bar ruptures and the shape calculated for the necked portion of the bar are in satisfactory agreement with the results of experiments.

Stresses Due to Tangential and Normal Loads on an Elastic Solid With Application to Some Contact Stress Problems, by J. O. Smith, Mem. ASME, and Chang Keng Liu, Jun. ASME, University of Illinois, Urbana, Ill. 1952 ASME Annual Meeting paper No. **52—A-13** (in type; to be published in the *Journal of Applied Mechanics*).

THE results of two-dimensional approach using real variable method to Hertz's problem of contact of elastic bodies are presented. Both normal and tangential loads are assumed to be distributed in Hertzian fashion over the area of contact. The magnitude of the intensity of the tangential load is assumed to be linearly proportional to that of the normal load when sliding motion of the body is impending. The stresses in the elastic body due to the application of these loads on its boundary are presented in closed form for both plane-stress and plane-strain cases. A numerical value of $f = 1/3$ is assumed for the linear proportionality (coefficient of friction) between the tangential and normal loads in order that the distribution of stresses may be illustrated. The significance of the stress distribution, across the contact area and in the body, is also discussed. It is shown that when the combination of loads considered in the paper is applied at the contact area of bodies in contact the maximum shearing stress may be at the surface instead of beneath the surface. For example, for plane strain, if the coefficient of friction is $f = 1/3$ the maximum shearing stress is at the surface and is 43 per cent larger than the maximum shearing stress, which would be below the surface, that occurs when the normal force acts alone. The effect of range of normal stress and of shearing stress on the plane of maximum shear and on the plane of maximum octahedral shear on failure by progressive fracture (fatigue) is discussed.

The Stress Distributions Induced by Concentrated Loads Acting in Isotropic and Orthotropic Half Planes, by H. D. Conway, Jun. ASME, Cornell University, Ithaca, N. Y. 1952 ASME Annual Meeting paper No. **52—A-14** (in type; to be published in the *Journal of Applied Mechanics*).

USING a Fourier integral method, the solution is obtained to an isotropic half plane subjected to a concentrated load acting at some distance from the straight edge. This problem was discussed previously by Melan, using a complex variable method of solution. The Fourier integral method is then extended to solve the corresponding problems of the orthotropic half plane.

ASME Transactions for December, 1952

THE December, 1952, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

The Elastic Sphere Under Concentrated Loads, by E. Sternberg and F. Rosenthal. (52—APM-37)

The Analysis of Fully Restrained Slabs Under Concentrated Loads, by C. A. M. Gray. (51—F-13)

Pressure Drops in the Pneumatic Conveyance of Solids, by Oscar Pinkus. (52—APM-30)

A Study of Vanes Singing in Water, by C. A. Gongwer. (52—APM-33)

Vibrations of Elastic Shells in a Fluid Medium and the Associated Radiation of Sound, by M. C. Junger. (52—APM-28).

Large-Deflection Theory for Orthotropic Rectangular Plates Subjected to Edge Compression, by Syed Yusuff. (52—APM-38)

Bending of a Uniformly Loaded Rectangular Plate With Two Adjacent Edges Clamped an the Others Either Simply Supported or Free, by M. K. Huang and H. D. Conway. 52-APM-14

A Nonlinear Problem in the Bending Vibration of a Rotating Beam, by Hsu Lo. (52—APM-35)

Plastic-Rigid Analysis of Long Beams Under Transverse Impact Loading, by M. F. Conroy. (52—APM-36)

Free Vibrations of Constrained Beams, by W. F. Z. Lee and Edward Saibel. (52—APM-31)

Deflection and Stresses in Beams Subjected to Bending and Creep, by Yoh-Han Pao and Joseph Marin. (52—APM-34)

Determination of Theoretical Plastic Stress-Strain Relations for Variable Combined Stress Ratios, by L. W. Hu and Joseph Marin. (52—APM-29)

A Simple Method of Determining Plastic Stresses and Strains in Rotating Disks With Nonuniform Metal Properties, by M. H. Lee Wu. (52—APM-25)

Combined Tension-Torsion Tests for Aluminum Alloy 2S-O, by Aris Phillips.

A Matrix Method for Flexibility Analysis of Piping Systems, by J. E. Brock.

Calibration of Pressure Gages for Work in Ballistics, by S. Raynor.

On Longitudinal Plane Waves of Elastic-Plastic Strain in Solids, by D. S. Wood.

Stress Singularities Resulting From Various Boundary Conditions in Angular Corners of Plates in Extension, by M. L. Williams.

The Stresses in a Flat Curved Bar Due to Concentrated Radial Loads, by C. W. Nelson, C. J. Ancker, Jr., and Ning-Gau Wu.

Gravitational Stresses on Deep Tunnels, by Yi-Yuan Yu.

On a General Method of Solving Second-Order Ordinary Differential Equations by Phase-Plane Displacements, by L. S. Jacobsen. (52—A-1)

Torsion of Uniform Rods With Particular Reference to Rods of Triangular Cross-Section, by Henry Nuttall. (52—APM-27)

DESIGN DATA AND METHODS

A Chart for Oblique Shock Waves in Water, by Reuben Bond and Werner Goldsmith.

Stress-Concentration Factors for Single Notch in Flat Bar in Pure and Central Bending, by M. M. Leven and M. M. Frocht.

BRIEF NOTES

Graphical Analysis of Axially Symmetrical Plates With Variable Thickness, by P. F. Chenea and P. M. Naghdi.

A Simple Approximation for the Natural Frequencies of Partly Restrained Bars, by N. M. Newmark and A. S. Veletsos.

Complementary Energy Analysis of the Failing Load of a Clamped Beam, by N. J. Hoff.

DISCUSSION

On Previously Published Papers by R. A. Clark, T. I. Gilroy, and E. Reissner; Leon Green, Jr.; M. C. Steele; H. M. Trent; Enrico Volterra; Harold Lurie; K. A. Gardner; and R. A. Toupin.

BOOK REVIEWS

ASME VIGOROUSLY ACTIVE *in* 1952

ASME Council Summarizes the Activities and the Results

THE ASME year ending Sept. 30, 1952, was remarkable for its vigorous and diversified activity. A sound and satisfying program of national services in meetings, publications, research, and codes and standards was supported by well-sustained activities in Sections and in the Student Branches, while maintaining their enthusiasm despite the reduction in number of Student Members. In the engineering profession there was progress toward unity, a start in the ECPD postcollege training program, a reassessment of the program of accrediting curricula, and progress in meeting the engineering manpower shortage. Internationally, there was fruitful participation in the meetings of the International Standards Organization, the ABC Conference,[1] and the Pan-American Federation of Engineering Associations; and progress was made in still closer relations with The Engineering Institute of Canada. There was a substantial increase in Society income, the result of increased dues and advertising, and a satisfactory growth in membership.

The dramatic event of the year was the Centennial of Engineering. Primarily conceived to mark the centennial of the American Society of Civil Engineers but broadened to celebrate one hundred years of engineering progress, and developed to bring into its program the other branches of the profession, it involved the time and efforts of many ASME officers and staff. The Centennial was a success. It is reported in more detail in MECHANICAL ENGINEERING for November, 1952, but it must be mentioned here because of its impact on the work of the Society during the year and later as its results unfold.

COMPLETE REPORTS AVAILABLE

In this report of the Council to the members, it is possible to include only selected high lights of the many activities of the ASME boards, committees, and representatives on joint agencies. These activities are reported in full in a separate pamphlet which is available on request.

WIDE MEETING OPPORTUNITY PROVIDED

The opportunities for the members to meet, provided by the Meetings Committee, the 21 Professional Divisions, 79 Sections, 7 Sub-Sections, and other agencies, added up to 4 National Meetings, 6 Divisional Conferences, and 917 Section meetings. Of our 134 Student Branches, 109 reported 675 meetings. Twelve Regional Student Conferences were held at which 128 students presented papers before audiences that totaled nearly 2000.

MEETINGS REVEALED TECHNICAL HIGH LIGHTS

Numerous technical presentations advancing important developments in engineering highlighted the activities of ASME during the year. For example, at the 1951 Annual Meeting the Power Division presented a series of papers on modern high-pressure high-temperature reheat steam turbines. Design, operation, performance, efficiencies, and service experiences were covered. As an aid to prevention of air pollution, a panel discussion on the low-load operation of spreader stokers, contributed by the Fuels Division, developed the various features of the present-day stoker which can be applied to produce smokeless operation during periods of low load.

This year's Applied Mechanics Division Conference featured a Symposium on Shock and Vibration Instrumentation. Some of the subjects covered were vibration pickup calibrators, instruments for measuring and recording shock-wave pressures and responses of structural members, shock and vibration instrumentation for ships, and dynamic testing of aircraft in flight.

A significant step in the disclosure of high-pressure studies was made by the scheduling of a Symposium on Measurement of High Pressures at the meeting of the Industrial Instruments and Regulators Division held in connection with the Annual Conference and Exhibit of the Instrument Society of America. Technical papers were presented from most of the engineering and research laboratories working in the field of high pressure, including those in universities, industry, and government. Recent advances and probable extensions were reviewed by Prof. P. W. Bridgman, Harvard University, the pioneer research worker in this field.

For the first time, during this year's Fall Meeting, a gas-turbine progress report was programmed by the Gas Turbine Power Division, embodying gas-turbine materials, cooling, and fuels; thermodynamics; and gas-turbine progress in the automotive, locomotive, aviation, marine, merchant vessel, naval vessel, and central-station fields, including specialized industrial applications. As the first such report, the document covers all phases of gas-turbine technology from the beginning to date. The Gas Turbine Power Division plans to issue similar reports at regular intervals.

The two sessions sponsored by the Wood Industries Division at the Fall Meeting were also part of the Wood Symposium presented during the Centennial of Engineering. Papers covered engineered plywood, woodworking machinery history, and a brief history of American forest products.

ENGINEERING LEADERS FEATURED AT MEETINGS

Dramatic features of the meetings were the invited speakers. Noteworthy were the talks of the president at the President's Luncheon, the opening feature at each national meeting. Other notables were the four Roy V. Wright Lecturers, W. C. Mullendore, Baldwin M. Woods, William C. Foster, and Ralph E. Flanders, and the two Calvin W. Rice Lecturers, Piero Ferrerio of Milan and L. Urwick of London. The participation of the ASME in the Engineering Centennial at Chicago led to the International President's Luncheon where eight presidents of American societies joined the ASME president in welcoming the presidents of engineering societies from 18 countries. Among the feature speakers at luncheons and banquets during the year were A. S. Alexander, Under Secretary of the Army; T. Keith Glennan of the Atomic Energy Commission, Arthur B. Langlie, Governor of the State of Washington; and Claude Seippel of Baden, Switzerland. At the Atlantic City Meeting, the Society provided the platform for the award of the John Fritz Medal to E. G. Bailey, the Gantt Medal to Thomas Roy Jones, and the Hoover Medal to William L. Batt. At the Cincinnati and Chicago Meetings, the National Junior Committee sponsored very useful sessions on professional development attended by selected representatives from the Juniors of nearby Sections whose presence was made possible by the Old Guard.

[1] Conference on Unification of Engineering Standards by representatives of Canada, Great Britain, and the United States.

TABLE 1 LIST OF ASME NATIONAL MEETINGS AND CONFERENCES

Meetings	Number of days	Number of sessions	Number of papers	Attendance
Fuels Conference				
Oct. 11–12, 1951, Roanoke, Va.	2	4	13	209
Annual Meeting				
Nov. 25–30, 1951, Atlantic City, N. J.	5	91	218[1]	4526
Spring Meeting				
March 24–26, 1952, Seattle, Wash.	3	17	43	566
Semi-Annual Meeting				
June 15–19, 1952, Cincinnati, Ohio	4	38	87	1240
Applied Mechanics (Eastern) Conference				
June 19–21, 1952, State College, Pa.	3	10[2]	47[3]	321
Applied Mechanics (Western) Conference				
June 26–28, 1952, Los Angeles, Calif.	3	5	16	75
Oil and Gas Power Conference				
June 23–27, 1952, Buffalo, N. Y.	4	6	15	405
Fall Meeting				
Sept. 8–11, 1952, Chicago, Ill.	4	36	92[4]	1282
Industrial Instruments and Regulators Conference, Sept. 8–11, 1952, Cleveland, Ohio	2	4	16	300
Petroleum Mechanical Engineering Conference, Sept. 22–24, 1952, Kansas City, Mo.	3	15	36	390
	33	226	583	9314

[1] 16 by ARS.
[2] Includes 2 symposiums.
[3] 7 Symposium papers.
[4] 9 by ARS.

As an aid to Section programs, the ASME Lectures were re-established on a trial basis by the Board on Technology before putting a full-scale program into effect in 1952–1953. Four lecturers appeared before 12 Sections.

MEETING INTENSITY INCREASING

Table 1 gives the statistics of National Meetings and Divisional Conferences during the year and reveals a 13 per cent increase in the number of sessions and a 17 per cent increase in the number of papers over the previous year. The attendance at the Atlantic City Annual Meeting was 25 per cent larger than the 1947 meeting in the same place but about 1000 less than a meeting held in New York. This reduction in participation was offset by the increased attendance at the Spring, Semi-Annual, and Fall Meetings and resulted in an over-all attendance increase of about 13 per cent compared to 1950–1951. These increases are an indication of the broadening scope and greater initiative of the Divisions and other program-planning agencies as well as an increased desire to provide a better service to the members.

More frequent program-planning conferences, more complete advance programs in MECHANICAL ENGINEERING, and increased efforts to have preprints in advance are further actions to improve member service.

Adoption of a new policy governing location and frequency of national meetings and their relation with Divisional and Regional Conferences brings the meeting pattern more nearly in accord with present problems of the Society.

PUBLICATION SERVICES ACTIVE

Publication services (based on 1951 calendar year) comprised 1576 pages of text in Transactions and the *Journal of Applied Mechanics;* 1020 text pages in MECHANICAL ENGINEERING, including digests of 290 Society meeting papers; 560 pages plus an 80-page index (4677 items) in *Applied Mechanics Reviews;* 16 codes and standards (600 pages) and eight special publications (900 pages). Sales of publications included 115,000 copies of technical papers, 40,000 copies of standards and codes, 10,000 copies of special publications, and 9500 subscriptions.

Advertising in MECHANICAL ENGINEERING totaled 1704 pages, an increase of nearly 18 per cent.

A new department "Brief Notes" relating to technical matters in mechanics was introduced in the *Journal of Applied Mechanics*. *Applied Mechanics Reviews* instituted a short feature article monthly, summarizing an important development in some section of the field of applied mechanics.

The *Applied Mechanics Reviews* showed a 20 per cent gain in number of subscriptions in 1952. Support has been received from government research agencies and the Engineering Foundation, but the Council has voted to terminate the publication at the end of 1953 unless it can be self-supporting.

PROFESSIONAL DIVISIONS ADVANCE

The Professional Divisions reports show uniformly successful activity during the year and indicate an encouraging interest in sponsoring new research projects. A new approach to better co-ordination between Professional Divisions was the organization of an agency known as the Lubrication Activity, to bring together the lubrication activities of several divisions and a Research Committee which were concerned with lubrication problems. The name of the Textile Division was changed to Textile Engineering Division.

A subcommittee of the Professional Divisions Committee made some progress in clarifying the organization of the Divisions and their relation with the Council and other Society committees.

RESEARCH PROGRAM REVITALIZED

The Society, through the guidance of eighteen special and joint committees, continues to render a unique service by planning and sponsoring researches whose results are valuable broadly throughout mechanical-engineering industries. Progress has been made in the following programs: Effect of temperature on the properties of metals, lubrication, metal-cutting data, high-temperature steam generation, boiler feedwater studies, furnace performance factors, and heat conductivity of gases. Plans for three new projects have been made: (1) Mechanical pressure elements, (2) heat conduction charts, and (3) low-temperature flue-gas corrosion and fouling. Contributions of $86,000 were received to support the individual projects. During the year the various research committees sponsored 25 sessions at national meetings.

A special Research Review Committee completed its report in which it expressed the conviction that a strong and vital research program is a necessary phase of the services of the Society to its members and to the profession. The report, approved by the Board on Technology but awaiting Council action at the close of the year, also recommended changes in committee structure to bring the Professional Divisions and the leaders in the current research programs into closer relation with the over-all problem.

CODES AND STANDARDS ADVANCED

The important international activity in codes and standards during the year is dealt with under another heading. The Board on Codes and Standards took 63 actions concerning the work and personnel of the 232 committees and subcommittees under its jurisdiction, the 17 committees which ASME sponsors jointly with other organizations, and the 91 ASME representatives on committees sponsored by other bodies. Seventeen codes and standards were approved during the year.

Following its policy of meeting outside New York each year, the Boiler Code Committee met at Toronto in April with excellent results in increased understanding by Canadian engineers, inspectors, and manufacturers about the work of the Committee and the codes.

DEVELOPMENT FUND

In 1944 the Council established a Development Fund as a separate fund for special projects designed to broaden knowledge of engineers, make available engineering data that would improve the practice of engineering, and aid industries which depend on a high degree of engineering skill. During the year the Development Fund was increased by $112,926.50 by donations from individuals and engineering companies.

WORK ON AIR POLLUTION STIMULATED

The work of the Committee on Air-Pollution Controls received a stimulus through the appointment of a full-time executive secretary to assist the Committee and its subcommittees in carrying out its objectives: (1) to initiate and co-ordinate research concerning the health, comfort, nuisance, engineering, and economic aspects of the problem; (2) to collaborate in the formulation and publication of standards of appropriate nature; and (3) to encourage and assist in the preparation, presentation, and publication of papers on the many phases of atmospheric pollution.

SECTIONS AND STUDENT BRANCHES GROW

The widespread membership and activity of the Society have long required a decentralization of leadership. Six years ago, this leadership was placed in the hands of the eight Vice-Presidents, one from each Region. They are concerned with the continuing progress of the Sections and the Student Branches. In excerpts from their reports which follow they reveal healthy conditions in the field. They point out that the smaller number of students in the junior and senior years has resulted in a smaller number of student members, but no reduction in enthusiasm.

Region I (New England) reported exceptionally good work by the Student Branches and a successful Student Branch Conference at Amherst, Mass., in which three Student Branches from the northeast area of Region III participated. The ten Sections reported successful years and intensive efforts to enlarge their committee structure to permit larger participation in Society activity. A successful Regional Administrative Committee meeting was held at Bridgeport.

Region II (Metropolitan New York area) reported an active Section year with 38 meetings and three dinner meetings with record attendance. Plainfield Section was added to Region II, giving an opportunity for improved program planning for the Metropolitan area. To provide meetings for suburbanites, Long Island and New Jersey Divisions have been formed and have proved successful. The Metropolitan Section has maintained its close contact with the New York City air-pollution problem. The student chairmen of the 12 Student Branches in the area meet monthly with the Section representatives to work out common problems. The Student Branch Conference was held at Columbia University. Section representatives participated actively in 35 high-school guidance meetings.

Region III (Midatlantic) reported an active year in Sections and Student Branches, with particular emphasis on increased civic interest in such problems as national water resources, engineering manpower, and civil defense. Excellent progress was made in getting closer relationship between the Student Branches and the nearby Sections. A very successful Student Branch Conference was held at the University of Maryland. The Regional Administrative Committee met at Corning and was well supported by the Southern Tier Section.

Region IV (South) reports an increased number of Section meetings, continued activity in the Student Branches despite reduced student enrollment, and a satisfactory increase in members. The Student Branch Conference, a highly successful affair, was held at Raleigh, immediately following the Regional Administrative Committee meeting in the same place. A new Section was established in Miami and a Sub-Section in Nashville.

Region V (Great Lakes) reported increased programs in the Sections, with especial interest in meetings of specialized character, principally machine design and management. Pittsburgh Section held a two-day mechanical-engineering conference. The Westmoreland Section was inaugurated. The Civic Responsibility Committee organized a speaker bureau to stress the matter of voting obligations. The Columbus Section participated in a series of television programs on "Engineering Your Life." The Regional Administrative Committee had an excellent meeting at Dayton. The Student Branch Conference at Akron drew a large attendance, the largest of any Region. New Student Branches were established at the University of Dayton and Ohio University.

Region VI (Midwest) reported continuance of activities in a spirited manner with a good Regional Committee Meeting at Davenport and two fine Student Branch Conferences at Houghton, Mich., and Indianapolis, Ind.

Region VII (Pacific Coast) reports the addition of two new Sections, Columbia Basin in Washington and San Diego, increased professional-division activity in the Southern California and San Francisco Sections, and well-attended meetings at the other Sections. Two successful Student Branch Conferences were held at Moscow, Idaho, and at Palo Alto, Calif., with papers of a high order of excellence. The Regional Administrative Committee meeting was held at Seattle preceding the Spring Meeting where an excellent program was presented before an attendance that doubled expectations.

Region VIII (Southwest) reports that the problem of reaching the widespread membership in the six Sections is being overcome by a wider selection of meeting places than usual. The 21 Student Branches, as is customary, met in three conferences: at Austin, Texas; Fayetteville, Ark.; and Denver, Colo. The Denver Conference was held simultaneously with the Regional Meeting and immediately following the Regional Administrative Committee Meeting, altogether a highly successful gathering. Region VIII is the only Region that holds a regional meeting and the Denver meeting was the final one in the three-year experimental period authorized by the Council. At the

TABLE 2 CHANGES IN MEMBERSHIP

Sept. 30, 1951 to Sept. 30, 1952

	Membership		Increases			Decreases			Changes			
	Sept. 30, 1952	Sept. 30, 1951	Transferred to	Elected	Reinstated	Transferred from	Resigned	Dropped	Died	Increases	Decreases	Net change
Honorary	54	53	2						1	2	1	+ 1
Fellows	380	360	30			2	1		7	30	10	+ 20
Members	13429	13108	312	482	94	30	193	190	154	888	567	+321
Associates	352	376	1	9	2	7	14	10	5	12	36	− 24
Junior (25)	3207	3185	543	26	44	178	111	293	9	613	591	+ 22
Junior (20)	1876	2188	577	39	27	632	76	245	2	643	955	−312
Junior (10)	18147	17398		3069	62	616	153	1596	17	3131	2382	+749
Totals	37445	36668	1465	3625	229	1465	548	2334	195	5319	4542	+777

Denver meeting, the Regional Meeting and the Student Conference were merged by having student papers and senior papers interspersed. This unique procedure proved very useful in bringing the students and older men together at the technical level. The success of the Regional Meeting experiment resulted in its continuance by the Council. A new Sub-Section was set up at Corpus Christi, Texas. The Mexico Section was attached to Region VIII, for a trial period of three years.

REGIONAL DELEGATES CONFERENCE

The Regional Delegates Conference met in Cincinnati to reach agreement on the recommendations of the eight Regional Administrative Committees and then met with the Council to present the results of their deliberations. Appropriate Society committees are considering the recommendations for early report to the Council.

EJC LEADS PROFESSIONAL ADVANCES

Progress in Unity. Further progress has been made toward greater unity in the engineering profession. In December, 1951, the Exploratory Group representing 15 societies issued a finalized report which offered a single plan, based on enlarging and modifying Engineers Joint Council. With the exception of one member, the Group approved this report as being the "most feasible proposal for inaugurating greater unity of the profession." The Executive Committee of ASME approved this report in principle and it was published in full, together with an editorial on the subject, in the March, 1952, issue of MECHANICAL ENGINEERING. This report was referred to the EJC societies for study and to the other societies in the Group for a statement of probable action if the recommended action is taken and an invitation is issued to join a unity organization. Of the 15 societies in the Group, seven have given favorable reply (including ASME), two stated they were withholding action, two have taken no definite action, one asked further questions, one did not approve, and two did not reply. On July 18, the Executive Committee of EJC submitted proposed amendments to the EJC Constitution to cover an enlarged EJC, recommending affirmative action and requesting specification of the ten nonconstituent societies they would accept as members of EJC. As of Sept. 30, 1952, three of the five constituent societies (including ASME) had agreed subject to a minor condition and one society stated it would act shortly. Four approvals are necessary to change the EJC constitution.

National Water Policy. In October, 1951, the revised "Principles of a Sound National Water Policy" and the "Critique" of the Report of the President's National Water Policy Commission were sent to each member of Congress. The House Committee on Public Works has set up a subcommittee to "study civil works." A representative of the EJC Panel appeared before this committee to present the EJC recommendations.

Engineering Salaries. EJC has continued to observe regulations and interpretations as they affect professional engineers under the Salary Stabilization Board.

The salaries of professional engineers employed in a professional capacity were excluded from stabilization regulations by a 1952 amendment to the Defense Production Act passed late in June, 1952. This was announced by the Salary Stabilization Board in Interpretation 12, July 2, 1952, which also defined "professional engineer" and "employed in a professional capacity." All other engineers remain under the stabilization control of SSB.

National Science Foundation. Engineering suffered a serious loss in the departure from the National Science Board of two engineer members, Dean Moreland by death, and Charles Wilson by resignation. As the result of strong representations to President Truman, the reappointment of Dean A. A. Potter to the Science Foundation Board for a full term of six years was secured.

World Power Conference. The Executive Committee of the newly reconstituted U. S. National Committee of the World Power Conference asked EJC to assume responsibility for the Committee's Secretariat, with the understanding that funds for the additional work involved would be provided by WPC. At its meeting on May 16, 1952, EJC agreed to accept this Secretariat.

UNESCO. An engineering exhibit, arranged for the Third National Conference of the U. S. National Commission for UNESCO, at Hunter College, Jan. 28–31, 1952, included panels showing the publications of the constituent societies of EJC and ASEE and "Faith of the Engineer" translated into several languages. During the meeting, engineers appeared as panel members of several engineering subjects. R. L. Goetzenberger, EJC representative on the U. S. National Commission for UNESCO, distributed a formal report of the meeting, including copies of addresses, all of which pointed to the increasing need for engineers to contribute more to UNESCO's thinking and guidance and the advisability of EJC societies giving more publicity to this subject in their monthly journals.

Engineering Manpower Commission. The Engineering Manpower Commission, the most important activity of EJC, made good progress in its threefold program: (1) To aid in maintaining a supply of trained engineers (in co-operation with ECPD); (2) to promote the most effective utilization of engineers in the national health, safety, and interest; (3) to aid in establishing the importance of the engineering profession in the national economy. Progress in these major programs included large mailings; newspaper publicity; radio and television programs; stimulation of activities of local groups throughout the country in co-operation with ECPD. Recommendations to government agencies to provide continued training of sufficient engineering and scientific students were made; EMC co-operated with Selective Service in student and occupational deferment plans. Co-operation with industry included information with respect to deferment procedures and furnishing information and appropriate data in connection with the shortage of engineers. A very successful one-day meeting was held in Chicago in conjunction with the Centennial of Engineering.

ECPD ADVANCES EDUCATION

The work of the Engineers' Council for Professional Development over the last year has made substantial progress through the various standing committees. Its Guidance Committee has been acting as a co-ordinating agency for the guidance activities carried on by the local sections of engineering societies and other counseling agencies. It has undertaken the issuance of a new guidance book and has co-operated with the Engineering Manpower Commission of EJC in supplying information to secondary schools of the country.

Its Education Committee, in its work in accreditation, finds its most serious problems coming from the rapidly changing development of engineering science and the practices of industry. As a result ASEE has been asked to make a far-reaching study of engineering education. A serious problem in accrediting is the recruiting of engineers from its constituent membership to serve on the various regional examining committees. The ASME Council authorized intensive efforts among ASME members.

Its Student Development Committee is now conducting a study of student branches and related activities of the constituent members of ECPD as well as other bodies. Its Recognition Committee has looked into the need for revising the Model Registration Law.

In 1950 ASME made funds available to ECPD for the use of its Training Committee in promoting the plan of five years of professional postcollege development of the young engineer. Arrangements have been made by the Training Committee of ECPD to initiate this plan in the city of Cincinnati in co-operation with industry, the local university, and the local engineering society. In this way the funds made available by ASME will be effective in the development of this long-range program.

INTERNATIONAL STANDARDIZATION

The International Organization for Standardization held its second annual convention in New York in June. Sectional Committees under ASME sponsorship covering screw threads, limits and fits, and machine tools attended the corresponding ISO technical committee meetings.

After observing first-hand the activities of ISO committees, the Board on Codes and Standards is convinced that American engineers must take part in an increasing number of international standardization projects through their national societies and that the societies should provide for this participation. In particular, the projects on pump testing, measurement of fluid flow, and the International Electrotechnical Commission's projects on Steam Turbine, Internal-Combustion Engines, and Hydraulic Prime Movers for which the ASME Power Test Codes Committee acts as the representative body from the United States of America, should be followed closely. Two meetings of the committee on measurement of fluid flow were held in Europe this year; an American representative attended both meetings.

Preceding the ISO meeting, at the request of the United States Department of Defense, a conference was held in the Society's offices of military and industrial groups from the United States, United Kingdom, and Canada to further the unification among the three countries of standards which vitally affect interchangeability of war material: standards for drafting practice, screw threads, pipe threads, and limits and fits. The results of this conference (detailed in the "ABC Conference Report—1952"—published by ASME) were so encouraging that similar conferences to further this work are being scheduled.

Following the London Conference, April 26-27, 1951, on sizes of nuts and bolts the responsible sectional committee resolved unfinished details. In April the Society published the American Standard for Sizes of Square and Hexagon Bolts and Nuts, which represents the agreements reached by America, Great Britain, and Canada.

A draft proposal for an international code for the acceptance of boilers and other pressure vessels has been submitted by the British Standards Institution to the ASME Boiler Code Committee which holds the secretariat for this ISO project. This has been circulated to the member bodies and comments are being collected. Plans are underway for a meeting early in 1953.

PAN-AMERICAN INTERESTS FURTHERED

The United States had the honor and privilege of entertaining the Second Convention of the Pan-American Federation of Engineering Associations (UPADI) at New Orleans, August 25–30, which proved highly successful. Three hundred and fourteen registered, 143 from the United States and 171 from other Pan-American nations, with delegations present from Argentina, Brazil, Canada, Chile, Colombia, Cuba, Dominican Republic, Mexico, Panama, Paraguay, Peru, Puerto Rico, and Uruguay as well as the United States. EJC holds the U.S.A. membership in UPADI and ASME was represented in the convention by Adolph Ackerman, Joseph Pope, S. E. Reimel (who acted as Recording Secretary of the Convention), and James M. Todd, past-president ASME, vice-president of UPADI, and General Chairman of the Convention Committee. In addition to a program of discussions on education and economic development and interesting visits to engineering and historic points, the Convention adopted a Constitution and accepted an invitation to meet in Sao Paulo, Brazil, in 1954. The Latin-American guests left, the majority going to Chicago for the Centennial of Engineering, with generous words of appreciation for hospitality shown at New Orleans.

CO-OPERATION WITH THE ENGINEERING INSTITUTE OF CANADA

During the year the revised agreement between The Engineering Institute of Canada and ASME was ratified and signed at a ceremony in New York by the two presidents. This agreement set up a joint body, the ASME-EIC International Council (in place of the previous joint committee), which reports excellent progress in securing better co-operation in announcing meetings of one Society to members of the other. The International Council sponsored a meeting of the ASME Boiler Code Committee in Toronto and aided in securing competent Canadian engineers for service on ASME technical committees.

NATIONAL MANAGEMENT COUNCIL

ASME is represented through its Management Division on the National Management Council which serves as the U. S. National Committee for the International Committee on Scientific Management. NMC has already started work on the program for the next International Management Congress in Sao Paulo, Brazil, in February, 1954. During the year, NMC acted as agent for the Mutual Security Agency in escorting productivity teams from Europe to the United States and in sending seminars from the United States to Europe. In particular, NMC escorted a mission of 170 engineers on a five-week tour which included participation in the Centennial of Engineering at Chicago. At the close of the year, NMC is redefining its scope and policy.

At the ASME Fall Meeting, during the Centennial of Engineering, NMC with the Canadian Management Council and the Brazilian Institute of Management sponsored a Western Hemisphere Management Conference under the general auspices of the International Committee.

UNITED ENGINEERING TRUSTEES

The United Engineering Trustees is the titular owner of the Engineering Societies Building, the Engineering Societies Library, and the Engineering Foundation. ASME representatives on the trustees report an improvement in the investment portfolio with gratifying returns. The building is fully occupied, with two societies, of which ASME is one, renting space outside. The elevator-renovation program was started but the noticeable obsolescence makes imperative some action for a new headquarters for the engineering profession.

ENGINEERING SOCIETIES LIBRARY

The Engineering Societies Library in New York, of which the ASME library is a part, served 17,585 visitors and received 21,255 requests by mail and telephone. The Library Board and staff have increased their efforts to promote the use of the Library; in the last twenty years income from the photoprint, microfilm, search, and translation services has tripled.

WOMAN'S AUXILIARY

The ASME Woman's Auxiliary reported an active year nationally as well as in the fourteen sections of which two, Detroit and Minnesota, were organized during the year. The

membership has grown from 989 to 1100. The Student Loan Fund is again becoming active. A full scholarship of $1500 has been awarded to an Italian student from the Calvin W. Rice Fund. The Sylvia Farny Scholarship was established to honor the first president of the Woman's Auxiliary. It will consist of $500 awarded annually to a student in mechanical engineering. Continued co-operation was extended to the ASME Meetings Committee in the conduct of the national meetings of the Society.

COUNCIL AND VICE-PRESIDENTS' MEETINGS

Two meetings of the Council were held during the fiscal year—during the Annual Meeting in Atlantic City, N. J., Nov. 25-26, 1951, and during the Semi-Annual Meeting in Cincinnati, Ohio, June 15-16, 1952. Representatives of the Council attended the Chicago Fall Meeting, Sept. 8-11, 1952, which was held during the Centennial of Engineering and at which the ASME was host to about 80 at an International Presidents' Luncheon on September 8. Meetings of the Vice-Presidents were held Nov. 27, 1951, in Atlantic City, N. J., during the Annual Meeting; on Feb. 22-23, 1952, in Chicago, and June 16-17, 1952, in Cincinnati during the Semi-Annual Meeting. Seven meetings of the Executive Committee of the Council were held.

PRESIDENT'S VISITS

At the close of his administrative year, the President will have attended meetings of approximately 48 Sections and 24 Student Branches. In addition, he attended the Annual Meeting in Atlantic City, the Spring Meeting in Seattle, Semi-Annual Meeting in Cincinnati, the Fall Meeting in Chicago, and the conferences of the Oil and Gas Power Division in Buffalo and the Petroleum Division in Kansas City.

DEATHS

Erik Oberg, Treasurer of the Society from 1925 to 1935, died Oct. 22, 1951. Also among those who died during the year were Forrest Nagler, on April 1, 1952, who served as vice-president of the Society 1948-1950; Harry M. Pflager, Feb. 13, 1952, Honorary Member; and James L. Walsh, June 13, 1952, who was closely identified with the national defense activities of the Society for many years.

SECRETARY'S OFFICE

Frederick S. Mallette was added to the staff to serve as Executive Secretary of the Committee on Air-Pollution Controls. A. F. Bochenek, news editor, resigned to take a position with the Central Intelligence Agency.

Ernest Hartford completed 40 years on the staff; Jean A. Brown, 35 years; Ivah L. Martin, 30 years; and 25 years of service were completed by Louisa C. Call and Ricky Hoffman.

The Council approved, by amendment to the Rules, a change in the office hours of the Society. Previously the office was open on Saturday morning until 1:00 p.m. The change provides for hours from 9:00 a.m. to 5:00 p.m. Monday through Friday.

ASME FINANCES SOUND

Financial statements summarized in this report show a substantial addition to surplus of $48,369.74 from operating income and other additions to reserves. The increase in dues voted by the members and improvements in handling advertising resulted in substantially increased income. The program of diversifying investments in the trust funds progressed with satisfactory results.

1951-1952 COUNCIL

R. J. S. PIGOTT, *President*

Past-Presidents

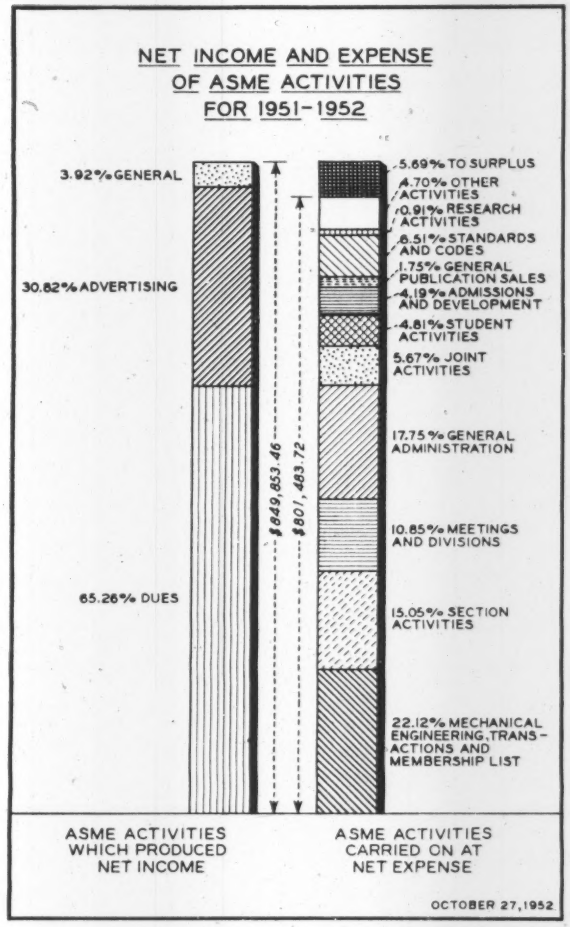
EUGENE W. O'BRIEN — JAMES M. TODD
E. G. BAILEY — JAMES D. CUNNINGHAM
J. CALVIN BROWN

Vice-Presidents

HENRY R. KESSLER — WILLIS F. THOMPSON
STEPHEN D. MOXLEY — ERNEST H. HANHART
JOHN T. RETTALIATA — ERNEST S. THEISS
CARL J. ECKHARDT — SAMUEL H. GRAF

Directors at Large

J. A. KEETH — LIONEL J. CUCULLU
RALPH A. SHERMAN — HAROLD E. MARTIN
BENJAMIN P. GRAVES — PAUL B. EATON
THOMAS E. PURCELL — ALBERT C. PASINI



ASME Finances

FINANCES[1]

THE income of the Society for the year of $1,566,292.64 was the largest income in the history of the Society. A net income over expense of $48,369.74 is reported. This amount plus initiation and transfer fees amounting to $21,825.00 makes a total addition to surplus for the year of $70,194.74.

The balance sheet of September 30, 1952 shows, on that date, that the Society owed:

(1) Current bills and federal tax withheld from employees		$ 11,002.17
(2) Obligations for printing and distributing the 1953 Mechanical Catalog and other bills which have not been submitted		$ 45,282.31
(3) Unexpended appropriations for future services		$ 119,240.73
(4) Future services to members who have prepaid dues		$ 194,995.18
(5) Advertising paid in advance		$ 234.00
		$ 370,754.39

To meet these debts the Society had:

(1) Cash in the bank		$ 90,547.35
(2) Accounts receivable		$ 138,434.62
(3) Inventories of publications and supplies conservatively valued at		$ 132,408.05
(4) Securities (at the lower of cost or approximate quoted market values)		$ 773,430.82
		$1,134,820.84

The difference between the value held by the Society of $1,134,820.84 and debts of $370,754.39 is the net worth of the Society on September 30, 1952 ..... $ 764,066.45

Against this the Society has set aside a General Reserve against contingencies ..... $ 600,000.00

This leaves a surplus of ..... $ 164,066.45

The Society administers a number of special funds. The condition of these is shown below:

(1) Custodian Funds

Special research and other committees which have collected funds for special services to be expended as needed ..... $ 212,869.26

Against which it had:

(a) Cash	$ 18,164.16	
(b) Securities (at the lower of cost or approximate quoted market values)	$194,705.10	
	$212,869.26	

(2) Development Fund of ..... $ 127,063.49

Against which it had:

(a) Cash	$ 8,159.32	
(b) Securities (at the lower of cost or approximate quoted market values)	$118,904.17	
	$127,063.49	

(3) Employees' Retirement Fund of ..... $ 182,283.59

Against which it had:

(a) Cash	$ 67,304.72	
(b) Securities (at the lower of cost or approximate quoted market values)	$114,978.87	
	$182,283.59	

(4) Trust Funds amounting to ..... $ 193,429.84

Against which the Society had the following assets:

(a) Cash	$ 52,813.26	
(b) Securities (at the lower of cost or approximate quoted market values)	$139,876.58	
(c) Notes receivable	$ 740.00	
	$193,429.84	

The Engineering Building is owned jointly by the major societies through United Engineering Trustees, Inc., ASME's interest, and other long-term assets are treated as a fully reserved fund:

[1] The certified report of the auditors, Price, Waterhouse and Company, is on file in the Society's office and available for inspection by the members.

(1) Property Fund of		$ 576,714.77
With these assets to support it:		
(a) ASME's quarter interest in real estate and certain other assets of the United Engineering Trustees, Inc.	$498,448.48	
(b) Office furniture and fixtures (depreciated value)	$ 78,265.29	
(c) Engineering Index, Inc. Title and good will	$ 1.00	
	$576,714.77	

Table 3 shows Society operations which produce net income and those which result in net expense. Table 4 shows income and expense by major groupings of Society activities.

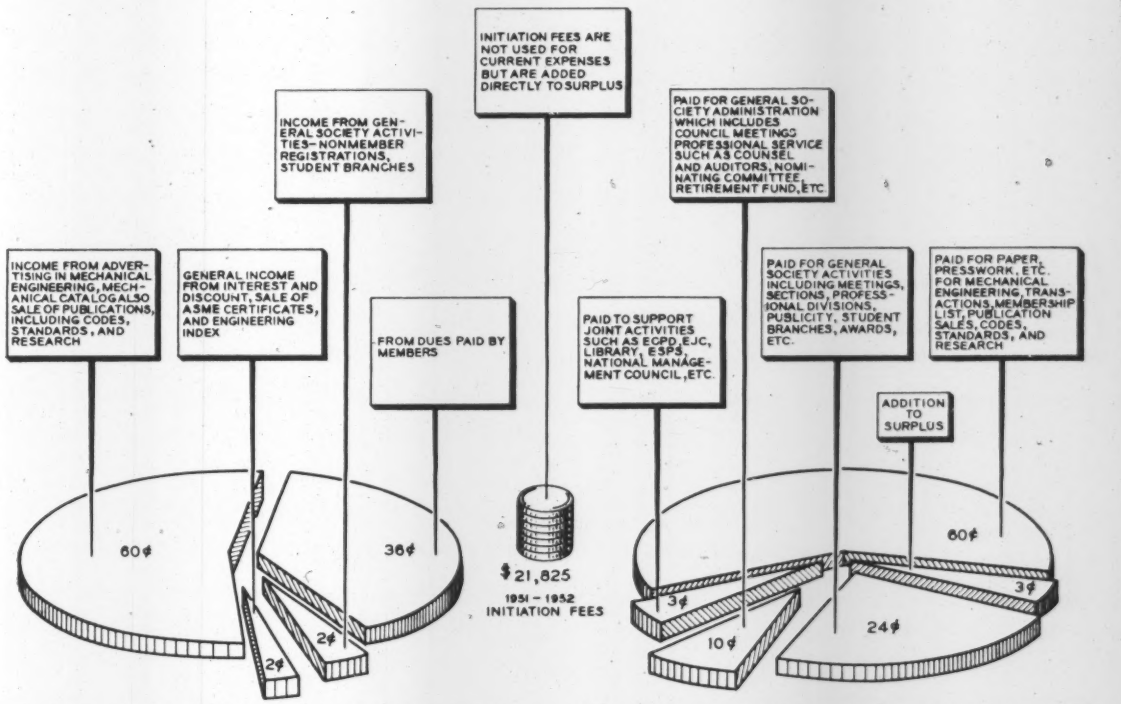
TABLE 3 ANALYSIS OF INCOME AND EXPENSE

(In this analysis, each expense item includes an allocated share of the indirect expense)

A	*Income items against which no charges are made*		
1	Membership Dues		$554,600.32
2	Interest and Discount		23,948.69
3	Miscellaneous Sales		5,107.84
4	Engineering Index, Inc.		4,262.17
			$587,919.02
B	*Activities which produce a net income*		
1	Advertising in MECHANICAL ENGINEERING and Mechanical Catalog	$708,483.91	
	Less: Expenses for producing advertising pages and selling the advertising	446,549.47	
			261,934.44
			$849,853.46
C	*Activities with some income which result in a net expense*		
1	General Publication Sales Income	$ 95,536.75	
	Less: Cost of producing publications sold, mailing cost, and selling cost	110,431.09	
			$ 14,894.34
2	Standards and Codes Income (from sales of publications)	$138,231.94	
	Less: Cost of producing codes and standards sold, mailing cost, selling cost, and servicing of committees	193,517.75	
			55,285.81
3	Research Income (from sales of research reports)	$ 2,039.02	
	Less: Cost of producing research reports sold, mailing cost, selling cost, and servicing research committees	9,751.59	
			7,712.57
4	Student Dues	$ 30,717.00	
	Less: Appropriations to Student Branches, cost of 12 student branch conferences, cost of copies of Mechanical Engineering mailed to Students, and cost of office service	71,593.89	
			40,876.89
5	Meetings Income (from registration fees)	$ 3,365.00	
	Less: Cost of meetings and cost of office service	70,621.89	
			67,256.89
D	*Activities Expense against which no income is credited*		
1	Mechanical Engineering Text Pages (costs of printing and mailing and editorial)		131,791.47
2	Transactions (costs of printing and mailing copies that are not sold and editorial costs)		41,486.13
3	Membership List (cost of compiling, printing, and editorial)		16,202.92
4	Sections (appropriations to Sections, costs of Regional Administrative Committees, cost of Regional Delegates Conference, travel in Regions, cost of office service and costs of national lectureships)		129,056.56
5	Professional Divisions (appropriations to Professional Division, and office costs)		24,956.14
6	Admissions and Development (office costs for Admissions Committee and Membership Development Committee)		35,583.55
7	Awards (cost of medals, prizes and certificates and office service)		1,726.94
8	Joint Activities (appropriation for library, ECPD, EJC, etc.)		48,227.34
9	General Administration (expenses of the Council, Retirement Fund, and office service)		151,426.17
10	Society Development (special 1952 appropriation for reserve to broaden service to members in Meetings and Publications		35,000.00
			$801,483.72
	Net Income		$ 48,369.74

TABLE 4 TOTAL INCOME AND EXPENSE FOR MAJOR GROUPS OF SOCIETY ACTIVITIES

	Expense	Income	Net	Expense per member	Income per member	Net Expense per member
Dues	....	$ 554,600.32	+$554,600.32	....	$14.81	....
General Income (interest, discount, emblem sales, Engineering Index Inc.)	....	33,318.70	+33,318.70	....	.89	....
Publications, Standards, Codes, and Research	$ 949,730.42	944,291.62	—5,438.80	$25.36	25.22	$0.14
General Society Activities (meetings, sections, student branches, admissions, etc.)	369,078.49	34,082.00	—334,996.49	9.86	.91	8.95
General Society Administration (Council, auditors, counsel, retirement fund)	150,886.65	....	—150,886.65	4.03	....	4.03
Joint Activities (Library, ECPD, EJC, etc.)	48,227.34	....	—48,227.34	1.29	....	1.29
Addition to surplus from operating income	48,369.74	....	....	1.29	....	1.29
Total	$1,566,292.64	$1,566,292.64	....	$41.83	$41.83	$15.70
Addition to surplus from initiation fees		21,825.00				
Total addition to surplus		70,194.74				


INITIATION FEES ARE NOT USED FOR CURRENT EXPENSES BUT ARE ADDED DIRECTLY TO SURPLUS
INCOME FROM GENERAL SOCIETY ACTIVITIES—NONMEMBER REGISTRATIONS, STUDENT BRANCHES
PAID FOR GENERAL SOCIETY ADMINISTRATION WHICH INCLUDES COUNCIL MEETINGS PROFESSIONAL SERVICE SUCH AS COUNSEL AND AUDITORS, NOMINATING COMMITTEE, RETIREMENT FUND, ETC.
INCOME FROM ADVERTISING IN MECHANICAL ENGINEERING, MECHANICAL CATALOG ALSO SALE OF PUBLICATIONS, INCLUDING CODES, STANDARDS, AND RESEARCH
GENERAL INCOME FROM INTEREST AND DISCOUNT, SALE OF ASME CERTIFICATES, AND ENGINEERING INDEX
FROM DUES PAID BY MEMBERS
PAID TO SUPPORT JOINT ACTIVITIES SUCH AS ECPD, EJC, LIBRARY, ESPS, NATIONAL MANAGEMENT COUNCIL, ETC.
PAID FOR GENERAL SOCIETY ACTIVITIES INCLUDING MEETINGS, SECTIONS, PROFESSIONAL DIVISIONS, PUBLICITY, STUDENT BRANCHES, AWARDS, ETC.
PAID FOR PAPER, PRESSWORK, ETC. FOR MECHANICAL ENGINEERING, TRANSACTIONS, MEMBERSHIP LIST, PUBLICATION SALES, CODES, STANDARDS, AND RESEARCH
ADDITION TO SURPLUS
60¢
36¢
2¢
2¢
$21,825
1951 – 1952 INITIATION FEES
3¢
10¢
24¢
3¢
60¢

WHERE ASME INCOME DOLLAR COMES FROM
TOTAL INCOME 1951-1952 – $1,566,292.64

HOW THE ASME INCOME DOLLAR WAS SPENT
TOTAL EXPENSES 1951-1952 – $1,517,922.90*
* ADDITION TO SURPLUS $48,369.74

1952 ASME ANNUAL MEETING

Marked by Program of Technical Sessions, Inspection Trips, and Social Events at Hotel Statler, New York, N. Y., Nov. 30–Dec. 5, 1952

WITH AN attendance in excess of 7000 the Seventy-Third Annual Meeting of The American Society of Mechanical Engineers got under way at the Hotel Statler, New York, N. Y., with sessions of the 1952 and 1953 Councils, on Sunday, Nov. 30, 1952, and continued through Friday of that week. Because of the pressure for meeting rooms, many sessions were held at the Hotel McAlpin.

The 136-page program of the Meeting, which listed also the sessions of the American Rocket Society, an affiliate of the ASME, included 444 authors and speakers, 181 papers and addresses, 97 technical sessions, 7 panels, numerous luncheons, dinners, and committee meetings, inspection trips, the events scheduled by the Woman's Auxiliary to the ASME, college reunions, and social gatherings. Concurrently with the Annual Meeting, The 20th National Power Show, with more than 300 exhibitors of the latest equipment, was in progress at the Grand Central Palace, New York, N. Y.

The general pattern of the Meeting followed that which has been in effect during recent years. The Council met at luncheon on Sunday and held its first session during the afternoon. Sunday evening was devoted to a general meeting of the Council, with representatives of the Sections, Divisions, Boards, and Committees, at which discussion was directed toward means by which the membership of the Society may be better served. C. B. Campbell, chairman, Publications Committee, opened a discussion of the Society's publication problems. Technical sessions, opening Monday morning, were held every morning, afternoon, and evening through Friday with the exception of Wednesday and Friday evenings.

In the pages that follow an attempt is made to cover the high lights of the Meeting and not the details of the technical sessions which, in most cases, are covered by abstracts of the papers published from month to month in this magazine. On pages 80–82 of this issue there appears a list of the papers available in preprint form. Some of these papers have been or will be published in MECHANICAL ENGINEERING, while others have been assigned to the Transactions of the ASME and the *Journal of Applied Mechanics*.

Other material relating to the Meeting and appearing in this issue includes the 1952 Report of the ASME Council and statement of finances, pages 45–53, and reports of the meetings of the Woman's Auxiliary, pages 95–97.

SESSIONS OF THE ASME COUNCIL

The 1952 Council met in three sessions during the 1952 ASME Annual Meeting at the Hotel Statler, New York, N. Y.—on Sunday, November 30, at 1:45 p.m.; on Monday, December 1, at 9:40 a.m. and 2:45 p.m. R. J. S. Pigott, president of the Society, presided.

ANNUAL REPORTS

The annual reports of the Council, Boards, Committees, and representatives on joint activities were accepted and the annual report of the Council was adopted. The reports of the Woman's Auxiliary were accepted with sincere appreciation of the achievements of the Auxiliary.

AMENDMENTS TO BY-LAWS

Amendments to By-Law B6A, Par. 12 (Boards and Committees) received for first reading at the June, 1952, Meeting of the Council, were adopted. Amendments to By-law B6A, Par. 17-b (Boards and Committees) were received for first reading.

BOARD ON HONORS

Approval was voted of the following policy for the guidance of the Board on Honors in selecting candidates for Honorary Membership: (1) An essential qualification for Honorary Membership shall be eminence in the engineering field; (2) up to five Honorary Members shall be selected each year; and (3) engineers throughout the world are eligible for consideration by the Board and it is the Society policy that from time to time Honorary Membership shall be bestowed upon eminent engineers from other countries.

MANUAL ON CITIZENSHIP

It was reported that the 1952 Regional Delegates Conference had proposed that the Engineers Civic Responsibility Committee draw up a statement of its aims and objectives and an outline of a program to accomplish them and that this statement, if approved by the Council, be distributed to Regional and Section officers. In view of the fact that the Engineers Civic Responsibility Committee had prepared and issued a Manual on Citizenship and Participation in Public Affairs, the Council considered that the purpose sought by the Conference had been served.

CUSTODIAN FUNDS

In May, 1952, the Executive Committee of the Council set up a committee headed by Ralph A. Sherman to review the policy on custodian funds which had been adopted in 1950. The Council reviewed the policy and suggested modifications. The revised statement of the policy was adopted and incorporated in the Rules of the Society.

POWER TEST CODES

Approval was voted of extension to Dec. 4, 1953, of the term of A. G. Christie as chairman of the Power Test Codes Committee.

On recommendation of the Power Test Codes Committee the Council voted to refer to the Finance Committee a request for the establishment of a custodian account on behalf of the joint AIEE-ASME Subcommittee on a Recommended Specification for the Speed Governing of Internal-Combustion Engine-Generator Units.

BOILER CODE COMMITTEE

Approval was voted of extension to Dec. 4, 1953, of the term of H. B. Oatley as chairman of the Boiler Code Committee.

DEVELOPMENT FUND

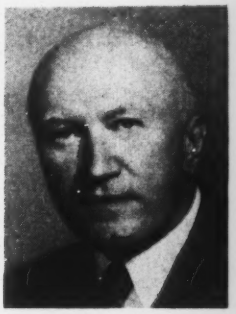
J. D. Cunningham, chairman of the Development Fund Committee, presented most recent figures on the B-Development Fund and announced the Committee's intention to terminate the collection effort as of Dec. 1, 1952.

New Members of the 1953 ASME Council

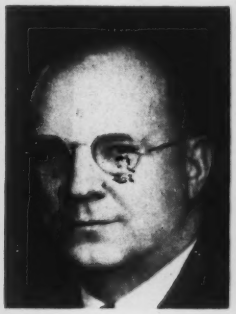
Regional Vice-Presidents

B. G. ELLIOTT

H. R. PEARSON

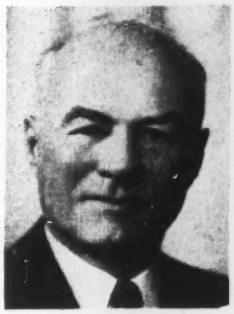


H. R. KESSLER

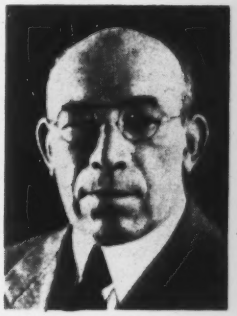


P. R. YOPP

Directors at Large



R. L. GOETZENBERGER



D. W. R. MORGAN

SPECIAL RESEARCH REVIEW COMMITTEE

The report of the Special Research Review Committee, together with detailed information on the history of the Committee and the financial program for 1952–1953 and 1953-1954, which had been distributed to the Council in advance of the meeting and had been approved by the Board on Technology, the Organization Committee, and the Executive Committee of the Council, was discussed at length. The Council voted to approve and put into effect the recommendations of the report and, subject to review by the Finance Committee, to authorize an appropriation from Research Reserve to initiate the program at the scale indicated in the report during 1952–1953.

NEW MEDAL AND AWARDS OFFERED

B. P. Graves, chairman of the Special Committee on Honors, reported a communication to President Pigott from A. C. Monteith, chairman of the Westinghouse Educational Foundation, proposing to ASME that it establish an ASME George Westinghouse Gold Medal "to perpetuate the value of the rich contributions to power development made by George Westinghouse, Honorary Member and twenty-ninth President of the Society" to be bestowed "for eminent achievement or distinguished service in the field of mechanical engineering." The Council voted to accept, with sincere appreciation, the offer of the administration of the ASME George Westinghouse Gold Medal, subject to review by the Board on Honors. The new medal will be endowed by a grant of $22,500 of the Westinghouse Educational Foundation.

Mr. Graves also reported that the National Machine Tool Builders Association had offered the ASME a "Machine Tool Design and Economic Value Award" for the best three papers submitted by members of ASME on the general subject of machine tools. The awards consist of $100, $75, and $50 for best and second and third best papers, respectively. The Council voted to accept with deep appreciation the offer of the "Machine Tool Design and Economic Value Award" for members of ASME, subject to review by the Board on Honors.

The Council expressed its sincere appreciation of the achievements of the Special Committee on Honors.

Fabian Bachrach

Frederick S. Blackall, jr.

President of The American Society of Mechanical Engineers for 1953

SOCIETY POLICY

A report of the Special Committee on Society Policy was accepted and it was voted to continue the Committee.

APPLIED MECHANICS REVIEWS

An encouraging report on *Applied Mechanics Reviews* led the Council to rescind a previous action and to pledge support through 1954.

BUSINESS MEETINGS

Discussion of the traditional pattern of business meetings of the Society resulted in an action of the Council to the effect that "Business Meetings of the Society should be conducted as at present with provision for extending the time usually allotted with a statement in the program and in MECHANICAL ENGINEERING that this meeting is intended primarily as an opportunity for members to discuss problems in which they are interested as an open forum."

ENGINEERS JOINT COUNCIL

Changes in the constitution of Engineers Joint Council will change ASME representation on EJC. ASME will be entitled to four representatives. These, and the alternates, were named by the Council as follows: R. J. S. Pigott, B. P. Graves, R. L. Goetzenberger, and C. E. Davies, representatives; and E. J. Kates, H. R. Kessler, L. J. Cucullu, and A. C. Pasini, alternates.

The Council empowered ASME to act for it in the event of the adoption of a Charter for Engineers Joint Council.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

G. R. Cowing, ASME representative on ECPD, reported briefly on the activities of the year, particularly the program of the Training Committee to which ASME made a contribution of funds in 1950. Mr. Cowing announced that arrangements were being made to initiate the plan in Cincinnati in co-operation with industry, the university, and the engineering societies.

R. J. S. Pigott

Retiring President of The American Society of Mechanical Engineers for 1952

AMERICAN PETROLEUM INSTITUTE

R. J. S. Pigott and H. V. Coes were added to the committee previously appointed to confer with the American Petroleum Institute regarding the joint API-ASME Code for Unfired Pressure Vessels. Other members of the Committee are B. P. Graves, H. B. Oatley, F. S. G. Williams, A. D. Bailey, and J. D. Cunningham.

ASME STAFF

In accordance with a practice, initiated in 1943, of recognizing members of the Secretary's staff who have served the Society for 25 years or more, the Council voted to extend to Frances Selig, member of the staff for 45 years; Katherine W. Clendinning and Louise J. Reinschmidt, members for 35 years; and Roy T. Modica, member for 25 years, appreciation for loyal and faithful service.

The Secretary introduced to the Council F. S. Mallette who joined the staff on August 1, 1952, as executive secretary of the ASME Committee on Air Pollution Controls.

CERTIFICATES OF AWARD

Certificates of Award were granted to the following:

Retiring chairmen of Sections: Arizona, H. C. Bigglestone; Central Illinois, H. D. Brown; Cincinnati, C. F. Hardy; Columbia Basin, W. W. McIntosh; Inland Empire, N. F. Hindle; Oregon, C. O. Heath; San Diego, W. C. Butt; San Francisco, H. A. Johnson; Utah, D. M. Schwartz; Western Washington, Conant Dodge.

Past chairmen of Sections: Arizona, W. A. Biddle (1949-1950); San Diego Sub Section, C. K. Sencebaugh (1948-1949); Richland, Wash., Group, E. M. Johnston (1950-1951).

Certificates of Award were also granted to: H. J. McIntyre, for his participation as general chairman of Seattle Spring Meeting, 1952; P. R. Duffey, who was responsible for calling the reorganization meeting of the Youngstown Section in 1947 and has been "largely credited by that Section with saving it from complete failure"; George Larkin and Darwin Brown, chairman and co-chairman, 1952 Semi-Annual Meeting, Cincinnati, Ohio.

D. S. KIMBALL

The death on Nov. 1, 1952, of Dexter S. Kimball, Honorary Member and Past-President of the Society, was noted with deep regret.

APPOINTMENTS

The following appointments were confirmed: Committee on Charles A. Coffin and Gerard Swope Fellowships (General Electric Co.), Alex D. Bailey; Committee to Celebrate Golden Jubilee of Powered Flight, F. S. Blackall, jr.

1952 ANNUAL BUSINESS MEETING OF THE ASME

The 1952 Annual Business Meeting of The American Society of Mechanical Engineers was called to order by R. J. S. Pigott, president, in the Keystone Room of the Hotel Statler, New York, N. Y., at 5 p.m. on Dec. 1, 1952.

Annual reports of the Council, Boards, and Committees were presented by the Secretary, and L. W. Houston presented the report of the Finance Committee for the fiscal year ending Sept. 30, 1952. (The substance of these reports will be found on pages 45 53 of this issue). For the record the Secretary listed property held by the Society and reported the number of members elected during the year and a list of members deceased. By motion the reports and actions of the Council and officers for the year 1951–1952 were approved.

The Secretary read the report of the tellers of election of officers as follows: D. W. R. Morgan and Ralph L. Goetzenberger, directors at large; Henry R. Kessler, Paul R. Yopp, Ben George Elliott, and Harry R. Pearson, vice-presidents; and Frederick S. Blackall, jr., president. These newly elected officers were introduced to members present by Mr. Pigott.

Henry R. Snelling commented on means by which the conduct of meetings could be improved and on the right of members to present their problems to the Business Meeting. W. J. King, President Pigott, Past-Presidents Alex D. Bailey and J. M. Todd, President-Elect Blackall, and the Secretary, joined in the discussion which followed.

L. W. HOUSTON, CHAIRMAN OF THE ASME FINANCE COMMITTEE, PRESENTS ANNUAL FINANCE REPORT DURING THE BUSINESS MEETING ON MONDAY

DINNERS AND LUNCHEONS

THE PRESIDENT'S LUNCHEON

The need for prompter information on technologic advance and the need for mass conference on unsettled questions were the two major influences that led to the formation of engineering societies, R. J. S. Pigott, president ASME, told members and guests at the President's Luncheon on Monday, December 1. Addressing the luncheon group on "The ASME and the Engineer," Mr. Pigott pointed out that the original purposes of ASME had very naturally expanded as soon as a working vehicle was established that could provide unbiased and top-level skills for the solution of many situations giving rise to industrial difficulties until standards of design or safety were developed and adopted. The ASME Board on Codes and Standards, he said, covers a most important field in design and test standards, as well as safety. In design, such subjects as pipe flanges and fittings, screw threads and wire gages, indicate the fields of standardization which have greatly aided industry.

There are 33 subcommittees concerned with standards. In boilers and other pressure vessels, not only safety but best standardized design of details is involved. Those of us who date back far enough can remember when a boiler built in New Jersey to New Jersey State Law could not be sold for use in other states, he said. Different designs were required for many states. Now the state laws have been largely adapted to conform to the ASME Boiler Code. This standardization means much greater safety, lower production cost, and lower delivery time.

In safety standards ASME has eight committees working, and it is interesting to note that with the exception of power transmission and compressed air, they are concerned with materials-handling equipment—elevators, cranes, conveyers, trucks—where the human personnel are engaged in operations which cannot be made automatic, in general, but depend on human skill and judgment.

In research, ASME has in all probability been the leader of national societies, Mr. Pigott stated. Up to 1915 the Main Research Committee had no funds for research and had to depend on the ability of members of the few subcommittees to get experimental service donated. About 1915, however, it was realized that to do effective research work money is necessary. In consequence, definite campaigns for funds on specific projects were undertaken, and today the Main Research Committee has 18 Special Research Committees and has collected several hundred thousand dollars for active investigations. This procedure, modified from time to time, has been extensively copied by sister societies.

Examples of the kinds of research profitably undertaken by ASME research committees include fluid meters, boiler feedwater studies, condenser-tube corrosion, lubrication, and metal cutting.

Mr. Pigott emphasized that it has been his practice for a generation to get the engineers on his own staff working on national society committees. It is an extremely useful continuation of anyone's college training, he said; moreover, it tends to keep the mind flexible.

Other values accruing from delivering papers and working on committees include (1) the association with other skilled engineers, and (2) the preparation and delivery of a technical paper, which, including the discussion that follows, is a valuable extension course in writing and public speaking.

According to Mr. Pigott, he has found, both from his own experience and from that of his staff, that committee work is highly valuable in directing a young engineer into his best line of specialization. More important still, chairmanship of a

PAUSING FOR A CHAT AT THE PRESIDENT'S LUNCHEON ON MONDAY ARE, *left to right:* INCOMING ASME PRESIDENT F. S. BLACKALL, JR., ASME SECRETARY C. E. DAVIES, AND RETIRING ASME PRESIDENT R. J. S. PIGOTT

committee entails a highly entertaining and instructive course in administration.

Mr. Pigott cited activities which the ASME carries on jointly with other engineering societies such as the water-supply policy of the Federal Government, the improvement of city and state highway construction, uniform road safety rules and markings, and the Government position on public and private power.

He also pointed out that we have Engineers Joint Council for our vehicle in the four "Founder Societies" and its scope is likely to be considerably increased both in field and society membership in the near future. Such matters as the compensation values for engineers (EJC), engineering manpower (Manpower Commission), and the rating of engineering curricula (ECPD) are at present part of our joint undertakings with other engineering organizations.

ASME joint operations are not confined to this country alone he stated, but spread internationally. For example, ASME works with the International Organization for Standardization and similar bodies.

According to Mr. Pigott, the ASME is naturally divided into two major phases of activity—that concerned with the Sections and that concerned with technology. The Sections activity, centering under the eight Regional vice-presidents, is concerned with the immediate activities locally, looking after the interests of Sections, groups, and student branches. It works at the grass roots, and is largely responsible for membership growth, and such social activities as our members like to add to their professional preoccupations, as well as the technical material locally.

Technology comes chiefly through the Board on Technology and the Board on Codes and Standards, working with the Professional Divisions as major agencies. Here the classification is not geographical but professional, and is country-wide instead of highly local. The Professional Divisions and the Research Subcommittees are a major source of papers for our national meetings.

Speaking on behalf of the Women's Auxiliary to ASME, Mrs. Frank W. Miller, president of the Auxiliary, extended greetings and welcomed members, guests, and their wives to the meeting.

J. Calvin Brown, past-president and Fellow ASME, presided at the luncheon.

HEAT TRANSFER LUNCHEON

Some of the problems which the heat-exchanger designer will encounter in the application of heat exchangers to commercial processes were outlined by W. E. Lobo, Mem. ASME, director, chemical-engineering division, The M. W. Kellogg Company, New York, N. Y., at the Heat-Transfer Luncheon, Tuesday, December 2. Speaking on "Problems in Heat-Transfer Application," Mr. Lobo gave a few such illustrations. It was pointed out that an early study of the phase conditions obtaining in petroleum mixtures handled at high temperatures and pressures might indicate the possibility of serious coking difficulties. A preliminary correlation of heat transfer in fluidized beds was shown and emphasis was placed on the effect of the geometry of the system on the results. The many new problems involved in the design of multistream exchangers with interconnected walls were outlined and the data on boiling ethylene heat-transfer coefficients were used as an example of our lack of knowledge in the heat-transfer field.

As part of the luncheon program, A. C. Mueller, Mem. ASME, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del., who presided, presented a Certificate of Appreciation to Prof. G. L. Tuve, head, mechanical-engineering department, Case Institute of Technology, Cleveland, Ohio, retiring member of the Executive Committee of the Heat Transfer Division.

HYDRAULIC DINNER

The traditional Hydraulic Old Timers Dinner was held on Tuesday, December 2. As in previous years the dinner was an informal affair which gave members an opportunity to meet in a relaxed congenial atmosphere to reminisce and tell each other stories and early experiences. The host was Andrew Liston, manager, hydraulic-turbine department, Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.

APPLIED MECHANICS SILVER ANNIVERSARY DINNER

This year's Applied Mechanics Division Dinner, held at the Columbia University Men's Faculty Club, commemorated the founding of the Division 25 years ago. R. E. Peterson, Fellow ASME and retiring chairman of the Applied Mechanics Division, who presided, presented the members of the executive committee and cited Dean G. B. Pegram and R. D. Mindlin for their work in arranging the dinner program.

Called on to make brief reports on the Division's activities, Dana Young, secretary of the Division, reported that 35 per cent more papers were handled by the Division this year than in 1951; J. M. Lessells represented the *Journal of Applied Mechanics*, and Martin Goland, *Applied Mechanics Reviews*. Dana Young then presented a Certificate of Appreciation to Mr. Peterson for his work on the Division's committee. Dr. N. J. Hoff announced that another Congress of Theoretical and Applied Mechanics is to be held June 14–18, 1954, at Ann Arbor, Mich.

Mr. Peterson also introduced the following past chairmen of the Division who were present at the dinner: S. P. Timoshenko, G. B. Pegram, J. M. Lessells, F. M. Lewis, J. A. Goff, E. O. Waters, C. R. Soderberg, R. Eksergian, J. P. Den Hartog, J. H. Keenan, J. N. Goodier, H. Poritsky, W. M. Murray, M. Goland, and R. P. Kroon. Mr. Peterson then called on C. E. Davies, secretary, ASME, who briefly addressed the group and congratulated the Division on its successful 25 years and on the Division's rise to its present stature.

Special tributes from abroad were also paid the Division by Prof. C. B. Biezeno of The Netherlands and W. Weibull of Sweden.

For the principal speaker at this memorable event, the Division was fortunate indeed in having Prof. S. P. Timoshenko talk on progress in mechanics in the past 25 years, particularly in the field of strength of materials. Greeted by a standing round of applause, Professor Timoshenko covered such subjects as thermoelastic properties under tension and compression, the yielding of materials, strain hardening, and plastic deformation. He pointed out that we now have a large amount of experimental information on high-temperature materials with the result that structures are now being designed on a completely new basis.

Great progress has been made in the past 25 years in stress analysis, he said, resulting in the possible lowering of factors of safety. Professor Timoshenko also cited the developments in elasticity over the past 25 years—thin-walled tubes, structures, and shells.

He closed his progress report with a note of sincere congratulation to the Applied Mechanics Division for creating a vehicle—meetings and publications—through which papers on applied-mechanics subjects can be presented and satisfactory discussion can be obtained. He also paid tribute to the *Journal of Applied Mechanics*, which, he said, is not only in high repute in the United States but has achieved renown throughout the world.

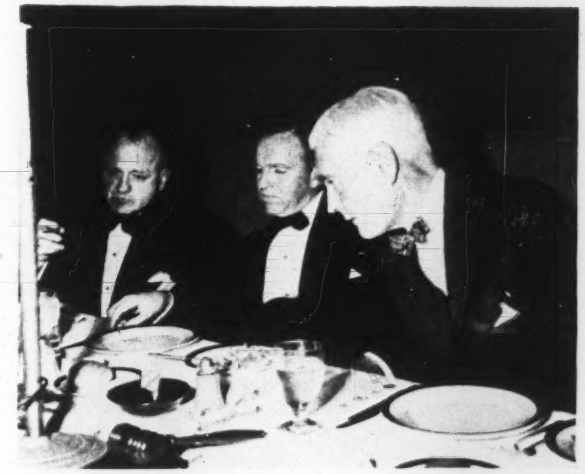
AVIATION DINNER

At the Aviation Dinner, Tuesday, December 2, that climaxed a daylong symposium on the government's $500 million heavy-press program for light metals, Under Secretary of the Air Force, Roswell L. Gilpatric, in his talk, "Research and Development and the Military Mind," stated that if we have to fight another world war we would have to depend less upon volume of armor and more upon superiority in science and strategy.

He refuted the accusation—some even from the men who today are piloting the planes—that the Air Force, by not freezing the designs of current models of aircraft, has run up the cost and complexity of advanced models by excessive "gadgetry" and "gimmickry."

Getting there first with the most—which has been the principle of our defense in three wars since 1861—is a policy which we can no longer follow for two reasons. Another war of attrition, fought by our old formula, Mr. Gilpatric

AT THE APPLIED MECHANICS DIVISION SILVER ANNIVERSARY DINNER ON TUESDAY, ARE SHOWN, *left to right:* PROFESSORS J. M. LESSELLS AND S. P. TIMOSHENKO, DANA YOUNG, R. E. PETERSON, RECEIVING THE DIVISION'S CERTIFICATE OF APPRECIATION, AND SECRETARY C. E. DAVIES



AT THE AVIATION DINNER

(*Left to right*, F. S. Blackall, jr., ASME President; the Hon. R. L. Gilpatric, undersecretary of the Air Force and principal speaker; and J. Carlton Ward, Jr., Mem. ASME, who acted as toastmaster.)

brought out, would, even if we were victors, leave us in far worse plight than World War II left England. The other reason why we cannot depend upon volume alone lies in the rapid advance of air power and atomic weapons. "In air combat," he added, "the only way to survive is through accuracy and speed—in short, performance."

He praised the technological development of the Sabrejets, F-86D, now in operation in Korea and predicted that in a few years the F-86D would be succeeded by the F-102, a delta-wing supersonic interceptor now going into production. However, he stressed the fact that the research and development branches of the military have not confined their forward thinking to weapons.

In industrial processes the Services are taking the lead in hastening the availability of titanium and are making great strides in the use of electronic computers.

"There is room and weight-carrying capacity in the F-86D," he said, "for still further improvement before they are replaced. There is not such room in the Russian MIG. It has about reached its peak of development. Of course, the Russians are already testing models to replace the MIG-15, just as we are testing models to replace the Sabrejet."

The fluidity of development thus made available, he went on to say, avoided the penalties of freezing types of planes for mass production. "Our pilots are shooting down MIG's today," he asserted, "not so much because of anything done in the past year, as because of the long-range planning which the Air Force did two, even three, years ago."

In telling of the many advances made in aviation through research and development, he said, "Each of these improvements was regarded as a new-fangled gadget when it was introduced, and many flyers resisted each of them. But anything that significantly increases aircraft performance is bound to be adopted sooner or later; and in military aviation, failure to lead the parade of progress would be fatal."

The program was cosponsored by The American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, the Institute of Aeronautical Sciences, and the Society of Automotive Engineers. Mr. Gilpatric was introduced by J. Carlton Ward, Jr., Mem. ASME, who acted as toastmaster.

IIRD LUNCHEON

"Abolition of want is the greatest news of our age," said Gerard Piel in his talk on "Control and Communication." Mr. Piel, publisher of *Scientific American*, was the featured speaker at the Industrial Instruments and Regulators Division Luncheon which was held on Wednesday, December 3.

His talk dealt with communication in the sense in which it relates to the men who are engaged in advancing the art of automatic control and as it applies to the men "who will be either the beneficiaries or victims of your art." In discussing automatization and the fear of technological unemployment he said, "When a machine displaces a man, that man knows it." From his narrow view he is unemployed. However, to the economists, who take the broad view, laborsaving machinery creates employment. A case in evidence was the British textile industry—but at the time the luddites sacked Hargreaves mill; they did not know that an expanding economy, made possible by automatization, creates more jobs. Today automatization has moved into automatic-control phase; even engineers wonder about the future employment of engineers. Instead of robots to run robots, the speaker stressed that more and better engineers would be needed. He cited the economic advances which have been made in stride with technical advancement. Some ask, Can we go on expanding? "The first prediction for the future," Mr. Piel said, "is that there will be no slackening of the trends that have brought us to where we are today out of the immediate past. In fact, the rate of innovation in our economy has been accelerating."

Free men believe we have destiny in our own hands—it's up to us to make the choice. There are some basic ideas that all should know in common. "Technological revolution has brought fundamental change in conditions of human existence, want and scarcity have powerfully conditioned man's relationship to man, slavery became obsolete a century ago only because machines made slaves obsolete. Today we have the means at hand to make technology outrun population. American economy is an example. It is the first in the history of the world to be worried by abundance."

A. F. SPERRY, *right*, RECEIVES THE 1925 IIRD AWARD FROM W. G. BROMBACHER AT THE IIRD LUNCHEON

Abolition of want is the biggest news of our age, yet it is known to comparatively few men outside the scientific community. A wider and profounder understanding of this piece of news would drastically change our approach to the question of the expanding economy and technological unemployment. As engineers "you are worried about what a war might do in accelerating the rate of automatization. As engineers, venturing into the field of politics, you come to a further conclusion that the primary threat of World War III resides with the social unrest not of the 'have,' but of the 'have-not' nations."

Talking about Point 4 and the UN Technical Assistance programs, he concluded, "These two programs would be carried on in a different spirit if your fellow citizens had a better understanding of the world that engineers and scientists have brought them into."

In recognition of his work on behalf of the division, H. L. Mason, Mem. ASME, was presented with a certificate of appreciation. Albert F. Sperry, Mem. ASME, received the 1952 IIRD Award. W. G. Brombacher, Mem. ASME, and chairman, Executive Committee, IIRD, presided at the luncheon.

ROY V. WRIGHT LUNCHEON AND LECTURE

The Roy V. Wright Lecture, since its establishment in 1949 in honor of Roy V. Wright, president of the Society in 1931, for his contributions as a citizen to the nation and his community, has become one of the high points of ASME national meetings. At luncheon on Wednesday, December 3, the Wright Lecturer, Alfred H. Williams, president, Federal Reserve Bank of Philadelphia, Philadelphia, Pa., speaking on the subject, "Business Leadership in a Democracy," declared that four basic elements are distinguishable in a program of training personnel for top leadership.

The first, he said, is technical competence. This may be defined as the understanding and mastery of a major field, such as engineering, merchandising, accounting, corporate finance, or personnel. Each field of American business is becoming increasingly technical and there will be no place at the top for the individual who does not know his specialty. The attempt to really master a specialized field can stir a man to his innermost core and bring rich returns not yielded by anything less thorough. The choice of a specialty should be related to natural aptitudes as we come to know more about the latter. This aspect of training for leadership should provide depth, he said.

ALFRED H. WILLIAMS DELIVERING ROY V. WRIGHT LECTURE AT WEDNESDAY'S LUNCHEON

The second basic element is broad intellectual interests. The businessman, he pointed out, should know history because history gives comprehension of social change. He should have a knowledge of foreign relations because this knowledge may give clues to intricate problems, broaden views, and make our prejudices a little more malleable. He should know good literature because good literature yields vicarious knowledge of life, furnishes fruitful analogies, puts us inside the being of others, draws us into the flow of human experience, and stimulates a sense of human experience. He should know other forms of government and thus obtain an awareness of other ways of group living and a basis for comparisons. This aspect of the new training for leadership should provide breadth.

The third basic element, according to Mr. Williams, is social intelligence—a capacity to understand and deal with men individually and in groups. There is a sharp need at the moment for intelligence in handling groups such as the employees of a company, the members of a trade union, or of a legislature. Consideration needs to be given to the application to business of the findings of the social sciences. This aspect of training for future leadership should provide insight.

Finally, he stated, the fourth element would be personal integrity. This phase would seek to stimulate in the erstwhile leader a construction of a well-knit set of values—ethical, moral, and spiritual. The aim here would be to set up a basic, central drive of respect for the individual man. Individualism in a very real sense underlies the entire development of life in America. Well-knit ethical and spiritual values serve to integrate the varied and sometimes conflicting loyalties of the individual leader, and provide the inner poise and strength so necessary if he is to achieve the Christian graces of magnanimity, affection, and loyalty. Business and union leaders of the type here demanded can be defined as individuals with the desire and capacity to develop their fellowmen. Training in this aspect of leadership would provide height.

Preceding Mr. William's lecture, incoming president, F. S. Blackall, jr., Fellow ASME, who presided at the luncheon, introduced Mrs. Wright. Mrs. Wright spoke briefly about Mr. Wright's work in civic responsibilities and expressed gratification and a deep appreciation to the Society for carrying on her husband's work.

FUELS LUNCHEON

A new approach to the application of fuels in a technical economy was presented at the Fuels Luncheon on Wednesday by Frederic O. Hess, president of the Selas Corporation of America, Philadelphia, Pa., and principal speaker of the occasion. A study of the fuel consumption in the United States for industrial purposes—as distinguished from domestic power generation, and transportation uses—discloses that our refined fuels—oil and gas—have a higher percentage of increase than our total national production. "This permits us to conclude," he said, "that the industrial consumption of fuel plays a proportionately higher role of importance in our productive plant."

Developing the economic background for this statement, Mr. Hess indicated that industrial oil consumption increased from 60,000,000 bbl in 1938 to 185,000,000 bbl in 1950, or by 208 per cent, and industrial gas sales increased from 7941 million therms in 1938, to 22,886 million therms in 1950, or 187 per cent.

In the same period our national gross product value or national expenditure increased from approximately 90 billion in 1938 to 282 billion in 1950, or 201 per cent. However, if we

HONORED AT ASME ANNUAL DINNER

(*Left to right*, Sanford L. Cluett, vice-president, Cluett, Peabody & Company, who received the Holley medal; Stephen P. Timoshenko, engineering consultant, formerly at Stanford University, who was made an honorary member; the new president, Frederick S. Blackall, jr., president-treasurer, Taft-Peirce Manufacturing Company; John M. Lessells, department of mechanical engineering, Massachusetts Institute of Technology and president of Lessells & Associates, also made an honorary member; and Nevin E. Funk, engineering consultant and former vice-president, Philadelphia Electric Company, who received the ASME medal.)

apply a correction for the depreciation of our money value to this dollar evaluation, let us say a sixty-six cent dollar in 1950 against 1938, our gross national product value increased only 132 per cent in this same 12-year period.

The percentage increase in the case of both oil and gas consumption as compared to the national product value represents that degree to which these fuels have been applied industrially.

Citing typical applications of fuels in industry, Mr. Hess described the use of oil and natural gas as a control medium in the production of high-octane gasoline. By a careful time and temperature heat-processing, an 8-point-higher octane rating can be attained—this without the customarily used tetraethyl lead.

The seamless-tube industry offers another important instance where high-strength-specification oil-well casings can be produced from plain-carbon steel by a carefully co-ordinated, timed, and controlled continuous heat-treating process which involves rapid heating to 1600 F, instant quenching, and short-cycle draw. Yield strengths of 110,000 psi are being attained regularly from this procedure. Thus a great saving in critical molybdenum and manganese for alloy steels has been accomplished.

Practically every industry is susceptible in some degree to Mr. Hess's philosophy that fuels must be considered as a processing tool of great flexibility and versatility. This tool not only is indispensable but more than any other governs the degree of progress and stability of a technical economy.

The luncheon program was conducted by William E. Reaser, Mem. ASME, Associate Professor of Mechanical Engineering, Princeton University, Princeton, N. J. John R. Michel of the Commonwealth Edison Company of Chicago, incoming chairman of the Fuels Division, presented Professor Reaser with a certificate of appreciation of the Society for his work as chairman of the Division.

ANNUAL DINNER

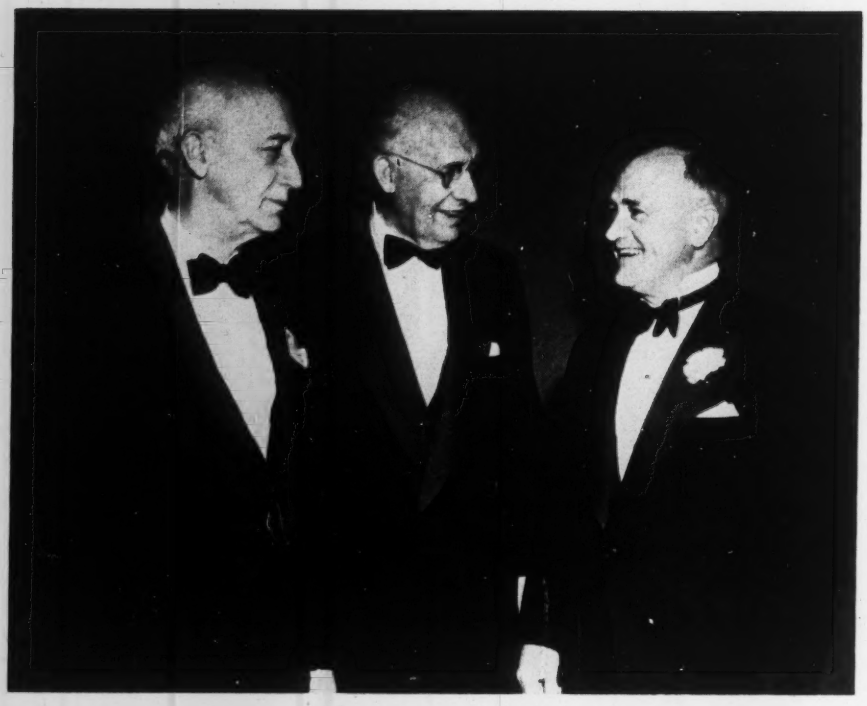
The Annual Banquet on Wednesday, December 3, the main social event of the meeting, which attracted an attendance of 1600 persons, was devoted to the conferring of honors and awards on distinguished members of the profession and recognition of outstanding young engineers and leaders in the engineering world.

Retiring president R. J. S. Pigott, acting as toastmaster, presented C. E. Davies, secretary ASME, who extended a welcome to distinguished guests representing the Engineers' Council for Professional Development, Engineering Societies Library, National Management Council, Daniel Guggenheim Medal Board of Award, New York State Board of Examiners, and sister societies, which were present at the dinner.

Mr. Pigott then introduced the following newly elected members of Council: Vice-Presidents, Henry R. Kessler, ASME Region II; Paul R. Yopp, ASME Region IV; Ben George Elliott, ASME Region VI; and Harry R. Pearson, ASME Region VIII; directors at large, David W. R. Morgan and Ralph L. Goetzenberger.

PRESIDENT BLACKALL SPEAKS

Next, Mr. Pigott introduced the new ASME president,



AT ASME ANNUAL MEETING

(*Left to right*, E. G. Bailey, vice-president, The Babcock & Wilcox Company; C. F. Kettering, research director, General Motors Corporation; with the 1953 ASME president, Frederick S. Blackall, jr., president treasurer, Taft-Peirce Manufacturing Company.)

Frederick S. Blackall, jr. In his brief acceptance speech, Mr. Blackall expressed deep gratitude for the honor bestowed on him and said that he hoped to see and greet many of the members of ASME in their own Sections and Regions during the coming year.

"I should be less than human," Mr. Blackall said, "were I not to express to you my great pride in being chosen as President of The American Society of Mechanical Engineers for the ensuing year. The honor is a very great one indeed, which is bound to be cherished by one in whose family a strong engineering tradition has spanned several generations. In the last one, both my father, whose name I bear, and my uncle, were members of ASME, and the latter, the late Prof. Charles Sumner Brown, head of the department of mechanical engineering at Vanderbilt University in Nashville, was active in the administrative affairs of the Society. Both of them proudly wore the Society's badge as far back as I can remember.

"It is, perhaps, from that tradition that I have inherited a profound belief that the major function of our Society is to maintain on a high plane the standards of the engineering profession. This ideal is stated succinctly and repeated indirectly in a number of ways in our constitution and by-laws. It has always seemed to me that in a sense it embraces all of the other objectives of the Society. We should never falter in our efforts to that end. Let mediocrity be the open sesame for others. The insignia of membership in The American Society of Mechanical Engineers should always be, to the fullest practicable extent that we can make it so, a special badge of competence in our chosen profession.

"The problems of a far-flung organization of 38,000 members grow more and more complex and throw an increasingly heavy burden of responsibility upon the President and the other officers of the Society. Some months ago, the Council adopted a code of principles of administrative procedure for the guidance of the President, in which the Council's desire was made abundantly clear that the President's personal appearance before a large number of the sections, however desirable such appearance might be, should give precedence to the more pressing problems of the Society at the administrative level. Of course no President of ASME can expect to meet his obligations without a great deal of travel, and I shall look forward to greeting many of you in your native settings during the coming year, but where that is not possible, I trust that you will bear with me and realize that I am simply obeying orders! Nevertheless, I do want you to know that, as a past Section chairman, no one could have a keener appreciation than I of the fact that the real progress of this Society is made at the grass roots. Thus you may be assured of a sympathetic approach on my part to the problems of sectional and regional activity.

"I thank you with all my heart for the confidence which you have placed in me in choosing me as your leader. I promise you that I shall do my best to live up to the great and distinguished tradition which has been established by my predecessors in this office."

50-YEAR MEMBERS

Secretary Davies then announced the following members, present at the dinner, who, for completing 50 years of membership in the Society were presented with special 50-year membership buttons by President Blackall: Louis Kossuth Comstock, William Dalton, John Woodman Higgins, Nicolai Henry Hiller, and Irving Edwin Moultrop.

The following 50-year members who were not present, it was explained, will receive similar recognition at appropriate occa-

tions in their own communities: Francis Blossom, Charles Harris Chase, Kern Dodge, David Gaehr, Joseph Parker Gazzam, Robert Ladd Gifford, Alexander Rodgers Goldie, Mark Lorin Ireland, Eugene Wycliff Kerr, Frederic Hale Keyes, Frederick August Krehbiel, Edward Philip Linch, Walter Richard Metz, Norman Irey Price, Joseph Wickham Roe, Charles Schenck, Walter Irvine Slichter, Russell Wellesley Stovel, and Charles Dutton Terry.

MEDALS AND HONORS CONFERRED

Secretary Davies announced that next year two new awards were to be added to the Society's already imposing list. These are the ASME George Westinghouse Gold Medal and a series of Machine Tool Design and Economic Value Awards.

The Undergraduate Student Award to George L. Stocking and the Charles T. Main Award to Israel E. Rubin, it was announced, were to be given during the Members and Students Luncheon on Thursday, December 4.

The following awards and medals were then conferred:

Pi Tau Sigma Gold Medal Award to Hubbert L. O'Brien, Mem. ASME, "for outstanding achievement in mechanical engineering within ten years after graduation."

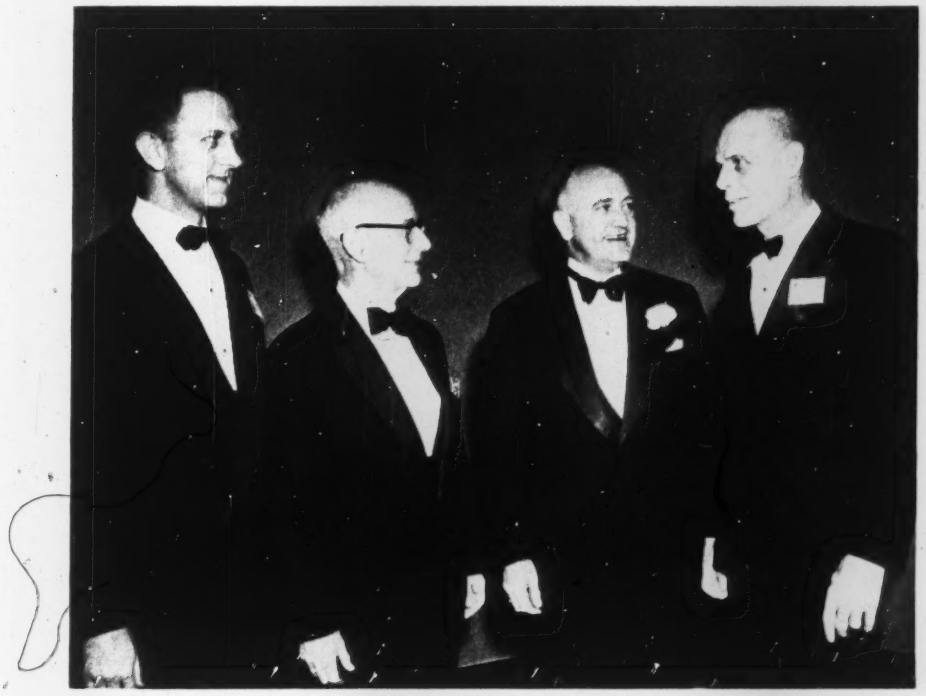
Richards Memorial Award to Jess H. Davis, Mem. ASME, "for outstanding achievement in mechanical engineering within twenty to twenty-five years after graduation."

Alfred Noble Prize to Myron Tribus, Jun. ASME, for his paper, "Intermittent Heating for Aircraft Ice Protection with Application to Propellers and Jet Engines."

Junior Award to Warren N. Rohsenow, Jun. ASME, for his

PI TAU SIGMA GOLD MEDAL AWARD

(Prof. Frank-L. Schwartz, presents award to Hubbert L. O'Brien.)



HONORED AT ASME ANNUAL DINNER

(*Left to right*, Warren M. Rohsenow of Massachusetts Institute of Technology, winner of the Junior Award; Max Jakob, heat-transfer consultant, Illinois Institute of Technology, who received the Worcester Reed Warner medal; the new ASME president, Frederick S. Blackall, jr., president-treasurer, Taft-Peirce Manufacturing Company; and Neil P. Bailey, head of mechanical engineering, Rensselaer Polytechnic Institute, who received the Melville medal.)

paper, "A Method of Correlating Heat-Transfer Data for Surface Boiling of Liquids."

Melville Prize Medal for Original Work to Neil P. Bailey, Fellow ASME, for his paper, "Flow and Combustion Stability."

Worcester Reed Warner Medal to Max Jakob, Mem. ASME, "for his outstanding contributions to science and engineering, particularly in the fields of thermodynamics and heat transfer; for a wealth of articles and books which have markedly enriched these fields; and for his leadership and inspiration as a scientific investigator and educator."

Holley Medal to Sanford L. Cluett, Mem. ASME, "for the invention of Sanforizing, an act of genius resulting in low residual shrinkage in fabrics, a great benefit to the textile industry and the public."

ASME Medal to Nevin E. Funk, Fellow ASME, "for pioneering achievements in economic operation of interconnected power systems."

Honorary memberships were conferred upon the following: John M. Lessells, Fellow ASME, "for outstanding contributions to the development of Applied Mechanics within The American Society of Mechanical Engineers. For his initiative and vision during the early days of the Division of Applied Mechanics, for his steadfastness of purpose in supporting it throughout the years, and for his long years of service in maintaining the high standards of the *Journal of Applied Mechanics*."

Stephen P. Timoshenko, Fellow ASME, "internationally known educator, eminent scientist and engineer, world authority in the field of applied mechanics, author of a score of books which have been translated into many languages and which have provided the basic theory for numerous practical problems of design."

This year's presentation of the Daniel Guggenheim Medal was also made at the ASME Annual Dinner. The Guggenheim Medal was conferred on Sir Geoffrey de Havilland, "for forty years of pioneering in military and commercial aircraft and the development of long-range jet transport."

PRESENTATION OF THE RICHARDS AWARD

(Prof. Frank L. Schwartz, mechanical engineering department, University of Michigan, presents the Richards award to Dr. Jess H. Davis, president of Stevens Institute of Technology.)

ALFRED NOBLE PRIZE

(Samuel W. Dudley, former dean of engineering, Yale University, with Myron Tribus, winner of the Alfred Noble prize.)

Because of ill health Sir Geoffrey was unable to be present and the Medal was accepted by his son, Peter de Havilland.

Further details about the foregoing honors and awards and their recipients can be found in an article, "ASME Honors Engineers," published elsewhere in this issue.

C. F. KETTERING DELIVERS BANQUET ADDRESS

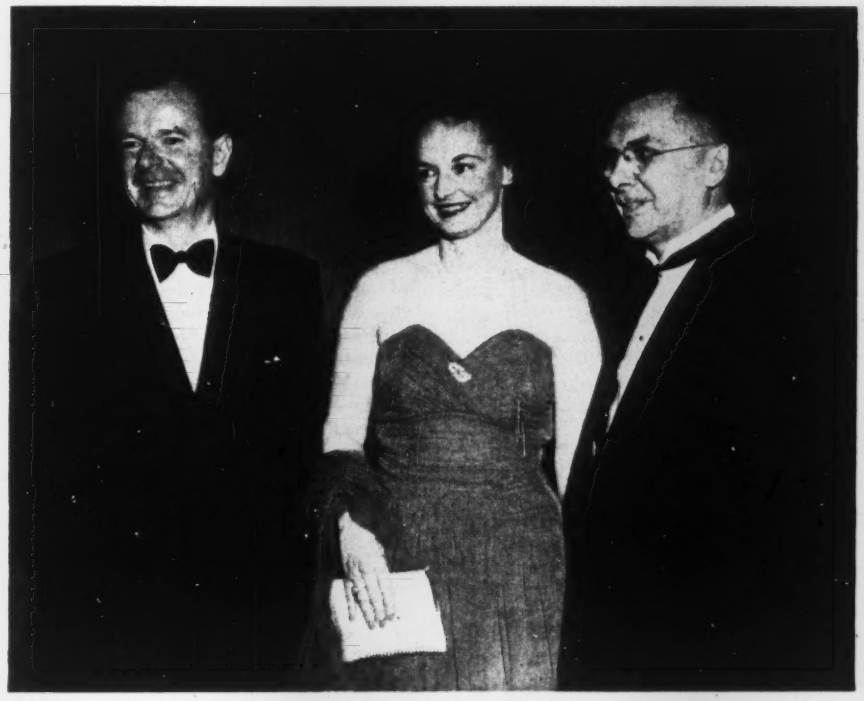
The principal address at the banquet was made by Charles F. Kettering, Fellow ASME, research consultant, General Motors Corporation. Speaking on the subject, "The Engineers' Responsibility in Educating the Public," Mr. Kettering emphasized that methods were necessary whereby engineers can tell the lay public what the vast amount of engineering work being done means to them and how it affects them.

Engineers, he said, should speak to high-school students, 4-H clubs, the Boy Scouts, Rotary Clubs, and the like, and explain some of our technical developments in simple understandable language. The public, he declared, should be taught that engineers are human beings and not a special cell of people. Engineers, Mr. Kettering stated, have contributed so much to make our way of life better that the public should know about their work—but in terms they can understand.

The traditional President's Reception, followed by dancing, was held at the conclusion of the Dinner program.

MEMBERS AND STUDENTS LUNCHEON

Members and student members from all sections of the country came together on Thursday, December 4, for the annual Members and Students Luncheon which was held in the Ballroom of the Hotel Statler, New York, N. Y. Retiring president, R. J. S. Pigott, Fellow ASME, presided. In his introductory remarks Mr. Pigott spoke briefly on the relation between the ASME and the engineer, discussing the benefits members get from the Society. These benefits he summed up as being able to get the latest engineering information about new discoveries and having its value established by means of dis-



GUGGENHEIM MEDAL IS PRESENTED

(Peter de Havilland, who accepted the Daniel Guggenheim medal for his father, Geoffrey de Havilland, presented b Hugh L. Dryden of the NACA at the 1952 Annual Meeting of The American Society of Mechanical Engineers. Mrs. Peter de Havilland is in center.)

cussion, and conference with other engineers about mutual problems. In Society committee work, he said, engineers get the beginnings of administration and in Society meetings, they get valuable public speaking and writing experience.

Mr. Pigott then presented the incoming president, F. S. Blackall, jr., who spoke on the "Objectives of an Engineering Education." The two major objectives of an engineering education, according to Mr. Blackall, are to teach students to acquire the laboratory point of view and to teach them how to think. The laboratory point of view he defined as seeking out the facts and when the facts are established, lining them up and guiding your decision on the basis of what the facts tell you. The great thing about engineering, Mr. Blackall said, is that it forces you to make rational decisions relatively untempered by personal prejudices. Mr. Blackall also warned young engineers against narrowing their field too much, and urged them to study philosophy and history and to develop a taste for literature and the arts. The best engineer, he said, is the broadest one.

Mr. Warner Seely, chairman, Board on Honors, then presented the Undergraduate Student Award to George L. Stocking, Iowa State College, 1952, for his paper, "High Temperature Electrical Resistance Strain Gages." He also presented the Charles T. Main Award to Israel E. Rubin, student member, from The Cooper Union School of Engineering, for his paper, "Engineering as a General Education."

The main speaker of the luncheon was Hubbert L. O'Brien, Mem. ASME, product manager, Conservation Equipment Division, Graver Tank and Manufacturing Company, Inc., East Chicago, Ind., who was the recipient of the Pi Tau Sigma Gold Medal Award. He spoke on "An Engineering Education, Its Application to Industry." The transition from student to practicing engineer is a slow and painful process, Mr. O'Brien said. The key to success in engineering, he continued, is not luck or genius, but diligence and hard work which in turn is the passport to luck. Mr. O'Brien discussed the merits of the various courses open to young engineers after graduation — training programs, graduate work, or straight engineering. He described several types of training programs and told of his own company's experiences with them. Graduate study

AWARD WINNERS ALL

[I. E. Rubin (*left*), Recipient of Charles T. Main Award, and G. L. Stocking (*right*), undergraduate student award winner, discuss a point with H. L. O'Brien (*center*) receiver of Pi Tau Sigma gold medal award and principal speaker at the members and students luncheon on Thursday.]

too, offers many advantages to young engineers. Many fellowships are available at universities and an engineer can sometimes earn as much as he would in industry while continuing his education. Then, Mr. O'Brien said, a young engineer can go into straight engineering. In a small company a young engineer will need to be versatile because of the variety of jobs he will be called upon to do and he will have to have the ability to get things done.

Mr. O'Brien also discussed a new type of engineering course which calls for a four-year course of fundamentals instead of the usual nomenclature courses. With this course, students would be taught to analyze and think and in the fifth year would specialize. This plan, Mr. O'Brien said, has been tried out in the engineering-mechanics department of Purdue University. Mr. O'Brien had this advice for young engineers—be active in engineering societies, publish papers, study after graduation, and register as a professional engineer. Lastly he said, develop intellectual honesty, and don't be afraid to admit your mistakes.

WOOD INDUSTRIES—FPRS DINNER

Research is a business and basically it can be compared with the usual manufacturing concerns, Carl A. Rishell, director of research, Timber Engineering Company, Washington, D. C., declared at the joint ASME Wood Industries Division—Forest Products Research Society dinner on Thursday, December 4. First, it must have a managing head. Second, it usually requires a factory or a laboratory where machines and facilities are available for producing a product. Third, but most important, it must have an adequate crew of trained personnel who have the brains and ability to make those machines operate. This then is a basic research organization, he said. However, back of that there must be an industry or some other adequate reason for all of the research facilities.

In his own case, he pointed out, this industry had to do with lumber and lumber products. It is an industry steeped in prejudices and outmoded practices. It is a proud industry in the knowledge that it has furnished comfort and shelter for every American for all time. It is an old industry that has been in existence for countless years and it is a new industry shaping its destiny to the mode of modern living. It is an industry where modernization is sometimes resented, he disclosed. These negative elements resent technical improvement and desire only that they be allowed to live in the past. But it is also an industry where there is even a larger and more important segment that believes in progress and has the will to bring this about.

R. R. SMITH (*right*), WHO PRESIDED AT THE JOINT ASME WOOD INDUSTRIES DIVISION-FOREST PRODUCTS RESEARCH SOCIETY DINNER ON THURSDAY, CONGRATULATES C. A. RISHELL FOLLOWING HIS TALK

The technical progress of the wood-using industry, Mr. Rishell emphasized, is solely dependent upon the training of young men in the fields of engineering, chemistry, wood technology, and other subjects that have to do with research in wood. These men will be trained if industry insists upon it and provides the conditions for employing them. The equipment for the laboratories, pilot plants, and other necessary things will be forthcoming automatically.

The principal job is to change the way of thinking of the people who presently administer the wood industry so that they will not view the industry of the future as a slight modification of our present plants and facilities, he said. When the sawmill operators become thoroughly convinced that their operations must be integrated with that of the pulp and paper industry or that they will have to be partners in the production of wood sugar or producers of soil improvers or in any of the other hundreds of ways for utilizing waste wood, then and only then can we hope to compete successfully with other modern industries. Unfortunately, he stated, not all of the people who are manufacturing lumber are looking this far ahead. Like most human beings they are afraid of the unknown. They resist change because to change requires effort and a certain amount of risk. Mr. Rishell said that he personally had no fear that the trend toward modernization of the wood-using industry will be stopped or that it will even be slowed up. The lumber industry has always produced a breed of men who have daring, who are intelligent. They have been among the principal organizers and builders of America. We are still producing the same kind of leaders with modern ideas.

R. R. Smith, Mem. ASME, treasurer, L. B. Ramsdell Company, Gardner, Mass., presided, and Thomas D. Perry, Mem. ASME, introduced the speaker.

JOINT FPRS ASME-WOOD INDUSTRIES LUNCHEON

Engineers have played too small a part in the home-building industry today, John C. Taylor, Jr., president, American Houses, Inc., declared at the joint Forest Products Research Society-ASME Wood Industries Division Luncheon, Thursday, December 4.

Mr. Taylor described a prefabricated house and a method of building it, thereby presenting one possible way of overcoming some of the "road blocks" which now exist. Aside from the foundation, he said, a house is made up of five main parts plus mechanical equipment for heating, lighting, plumbing, and, in some instances, air conditioning. The five parts are the floor, exterior walls with openings, interior partitions with openings, ceiling, and roof. The function of each of these five parts is well known and the required characteristics as to strength, rigidity, resistance to weather, are all a matter of record. Testing procedures have been well established as well as costs of material, labor, transportation, and financing.

We know, he pointed out, that we can ship by truck panels 32 ft long × 8 ft wide. Therefore we should have in a 24 × 32-ft house only three floor panels 8 × 32 ft. These panels must be complete with finish surface, insulation, sufficient strength, and rigidity to meet all floor requirements for housing, and placed at an 8-ft span. The weight must not be more than 4 lb per sq ft.

For exterior walls, he said, a similar material or composition of materials out of which, in a factory, not more than 350 to 400 miles from the site, full wall sections can be assembled, with windows and doors and insulation, up to 32 ft in length and up to 8 ft in height, and weighing not over 3 lb per sq ft. The same applies to partitions, with the weight not exceeding

2 lb per sq ft, ceilings not more than 2 lb, and roofs from 3 to 3½ lb. Using such a material, Mr. Taylor stated, we would enclose a house with three floor panels, four side walls, two gables, and not more than four roof sections, a total of 13 pieces, each of which could be unloaded and erected by hand labor at the site.

Such a material or composition of materials, he said, will fit in beautifully with current architectural trends. Transportation costs would be at a minimum; field erection as to time and cost would be at a minimum. In fact, if the foundations were ready, building a home should be a matter of 3 or 4 days at most, because each erected part would be completely finished except for the final coat of paint, in case the material used needed painting.

One of the expensive items in houses today, according to Mr. Taylor, is the equipment for heating, lighting, plumbing, and the like. Even in our prefabricated houses these jobs are done by subcontractors in the same manner as they are done for conventionally built homes. Once we have worked out our goal of building the house enclosure as we think it should be built, the improvement in the mechanical gadgets will follow, he said. The panels will be shipped wired, cutting for the trades will be done, and all the equipment will be shipped for rapid installation.

Spread all over such a development, Mr. Taylor declared, engineers are needed to develop the basic material, work out connectors, develop new mechanical equipment, plus a host of other requisites.

Frank T. Parrish, Heywood-Wakefield Company, Gardner, Mass., presided.

TEXTILE ENGINEERING LUNCHEON

Speaking on the subject, "Employee Attitudes and Productivity," Douglas Williams, president, Douglas Williams Associates, New York, N. Y., told ASME members and guests present at the Textile Engineering Luncheon on Friday, December 5, that the primary sources of productivity are (1) Making machinery more automatic—so one man can handle a multiple number of machines, instead of one; (2) the mechanization of materials handling—such as mechanical lifting and conveying devices; (3) the standardization of parts, and making them interchangeable; and (4) job simplification and specialization, so that an employee can develop a high degree of skill and speed on an easy task.

It is principles such as the foregoing, he said, that represent the basic sources of productivity, and increases in productivity. However, he emphasized, proper employee attitudes are an essential ingredient if the foregoing principles are to be realized up to their full potential. Granted, for example, that it is of first importance for a textile mill to have the most up-to-date looms, with the most recent automatic devices, it is then of critical significance that the weavers be motivated to turn out top quantity and quality on those looms—or the company's investment in the machinery won't pay off at the desired level of increased productivity.

The employer, as manager, Mr. Williams pointed out, must recognize the employee as the whole man he is; that his job is a big and important part of his life, and that to provide whole satisfaction for the whole man, the job must have meaning for him—if he is to be motivated to be productive-minded.

He needs to understand the part his job plays in the operations of the department, the division, the company. He needs to be informed on company plans and industry developments, so that his instinctive feeling of pride in his outfit is nourished. He needs to be consulted on moves that affect him or his job, so that he has an opportunity to participate, and to develop a feeling of identity with the organization.

AT THE TEXTILE ENGINEERING DIVISION LUNCHEON ON FRIDAY, *left to right:* LINDSEY DEXTER, DOUGLAS WILLIAMS, THE SPEAKER, AND F. D. SNYDER, WHO PRESIDED

It is becoming increasingly true that employees need and want nonfinancial rewards from their jobs as well as financial; and that unless they get these social satisfactions from their work, they will not be motivated enough to be productive-minded in their jobs.

F. D. Snyder, Mem. ASME, consulting engineer, Westinghouse Electric Corporation, Boston, Mass., presided over the luncheon.

AMERICAN ROCKET SOCIETY DINNER

The annual dinner of the American Rocket Society on Thursday evening was the high light of the three-day seventh annual convention of the society, held in conjunction with the 1952 ASME Annual Meeting. It was devoted to the introduction of prominent guests and outstanding members, the presentation of awards, and the announcement of newly elected fellows and officers. Lieut. General Laurence C. Craige, Deputy Chief of Staff of Development, USAF, was the principal speaker.

C. W. Chillson, president ARS, who presided, entrusted the original ARS Test Stand to the custodianship of Reaction Motors, Inc. R. W. Young, president of the company, accepted it after the "museum piece" had been carefully described by G. Edward Pendray.

Then the men who were honored by election to Fellow grade of membership in the society for their distinguished contributions to the advancement of rocket science and those who had served the society outstandingly were introduced. They were: William L. Gore, Aerojet Engineering Corporation; Roy Marquardt, Marquardt Aircraft Corporation; John Sloop, NACA, Lewis Flight Propulsion Laboratory, Cleveland, Ohio; Wernher von Braun, Department of Ordnance, U. S. Army, Redstone Arsenal, Huntsville, Ala.; and Weldon Worth, Wright-Patterson Air Force Base, Dayton, Ohio.

The following honors were conferred:

The 1952 ARS Student Award for undergraduate work of outstanding significance in rocket science was presented to Richard W. Foster, a freshman at Purdue University, by R. W. Young, chairman ARS Awards Committee.

M. J. Zucrow, of Purdue University, received the G. Edward Pendray Award for outstanding literature in the field of jet propulsion. In addition to his academic duties, Dr. Zucrow is a consultant for both Government and industry. Dr. Pendray presented this award.

The C. N. Hickman Award was presented to A. L. Antonio, of Aerojet Engineering Corporation, for his developments in the solid-propellant rockets field. Dr. Antonio has been in

charge of that work at Aerojet since 1945. This award was presented by R. W. Young.

Richard W. Porter, of the General Electric Company, received the R. H. Goddard Memorial Lecture Award for his achievements in the liquid-propellant rocket industry. Dr. Porter is engineer in charge of the GE-Army Ordnance "Project Hermes," a guided-missile research and development program sponsored by the Ordnance Department, USA. In the absence of Mrs. Goddard, Dr. Pendray presented this award.

General Craige chose "The Practical Translation of Rocket Power to Air Power" as his topic for the featured address of the occasion. In urging the assembled scientists to lay aside temporarily their efforts to conquer space and exercise every means in their power to the mastering of immediate problems currently confronting us, he said, "Our enemies, as we know them, are not located on another planet, or on the moon."

He reviewed the science of rockets and said that for several hundred years the rocket-propulsion device had been applied intermittently as a military weapon although it had not been universally applied and recognized as a powerful component of air and ground weapons until the last decade. He told of the rocket-powered V-2 used by the Germans in World War II and later how the first manned flight through sonic barrier by X-1 was made possible and added that one could not mention modern rocketry without acknowledging the importance of the Bazooka.

AMERICAN ROCKET SOCIETY LUNCHEON

In his talk on "Space Superiority, A New Concept for the Preservation of World Peace," before the American Rocket Society Luncheon gathering on Friday, December 5, Wernher von Braun stressed the feasibility of the building of a so-called artificial satellite that would travel in a fixed orbit around the earth. Now we must take a bold new step, he added, because the gap between our developments and advancements of the strategic bombers, atomic bombs, or hydrogen bomb is fast closing in the competition with our enemy—we must be first in the development of this new concept.

Dr. von Braun is the technical director of the U. S. Guided Missile Development Group at Huntsville, Ala., and one of the world's top rocket authorities, who directed the development of the German V-2 Rocket.

Confident that scientists can place and man an impregnable fortress in space 1000 miles from the earth, he urged the immediate build-up of scientific efforts toward establishing the satellite to curb military aggression. The satellite, traveling at about 50,000 miles an hour, according to calculations by Dr. von Braun and others, equipped with powerful cameras and telescopes, could patrol and investigate the face of the earth once every 24 hours. The station could also be used as a launching platform against which there could not be effective countermeasures. Once in place the first space station could prevent the establishment of any other station, he added, in reply to those who have described the orbital stations as defensible as "sitting ducks."

LARGEST TECHNICAL PROGRAM SCHEDULED

The technical program which consisted of some 250 papers presented at 96 technical sessions made this year's Annual Meeting the largest ever scheduled by ASME. Included were 21 papers scheduled by the American Rocket Society, an affiliate of ASME. The array of engineering papers, research reports, progress reports, symposiums, and panel discussions covered developments, methods, and procedures which touched nearly every conceivable industry.

AIR-CARGO DAY

One of the most popular events during the meeting was the fourth annual Air-Cargo Day program sponsored jointly by the Aviation and Materials Handling Divisions of ASME, Society of Automotive Engineers, Institute of the Aeronautical Sciences, and the National Security Industrial Association. In a series of symposiums, overflow crowds heard air-cargo authorities stress that greater speed in handling of air cargo at airport facilities was necessary. And airline specialists urged the development of new freight aircraft with high tonnage capacity and low operating costs as mandatory for the future of the air-freight industry. Turning to military transport planes, the U. S. Air Force revealed that three of the nation's major aircraft manufacturers are now studying jet transportation for the Air Force. "System study contracts" were let last spring to compare reciprocating engine, turboprop, and jet air transportation and confidence was expressed that the jet engine will find a place in the Air Force.

VIEW OF ONE OF THE CROWDED SESSION ROOMS DURING THE ASME HEAVY-PRESS PROGRAM

HEAVY-PRESS PROGRAM

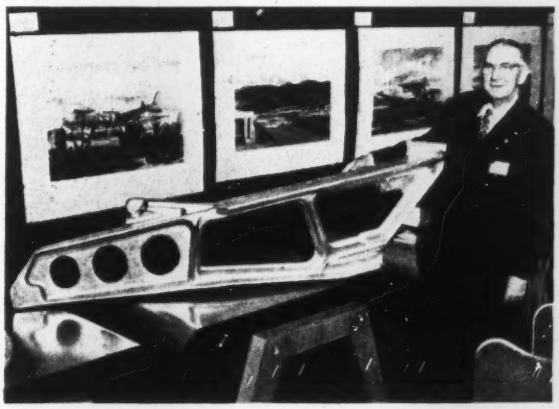
Another symposium which created great interest among the engineers present at the meeting was the Government's $500,000,000 heavy-press program for light metals. Purpose of the program was to emphasize to aircraft-design engineers the need for the expanded utilization of large and more complex forged and extruded structural components in forward aircraft designs. The symposium, sponsored jointly by the Aviation, Machine Design, and Metals Engineering Divisions of ASME, Society of Automotive Engineers, American Institute of Mining and Metallurgical Engineers, and the Institute of the Aeronautical Sciences, presented to "standing-room-only" crowds all the principal elements involved in the problems of the creation and the utilization of such new components. Subjects covered included aircraft-industry requirements for large forgings and extrusions, design and construction of large forging and extrusion presses, metallurgy, and production of suitable aluminum-alloy ingots for large forgings and extrusions, and large forging-press and extrusion-press operations and production problems. The use of these mammoth presses—which will exert forces up to 50,000 tons—are expected to revolutionize some aspects of aircraft design and manufacturing, thereby reducing costs of military planes.

AIR POLLUTION

The symposium on air-pollution control and its varied aspects, sponsored jointly by the Fuels and Power Divisions, and the Committee on Air Pollution Controls, enjoyed great popularity. Meanings of the term air pollution and its effects from the viewpoint of nuisance, health, animals, vegetation, and economics were reviewed. The health aspects of air pollution were discussed in detail and facts gained from the study of industrial gases and fumes have enabled comparisons to be made regarding the average concentrations of air pollution over cities which indicate that, under ordinary conditions, gases and fumes do not occur in amounts sufficient to justify apprehension as to their effects upon health.

On the other hand, it was revealed, many air pollutants around large cities and industrial areas are toxic to plants if the concentration is great enough and the exposure long enough.

The importance of diffusion by atmospheric turbulence and the use of tall chimneys and high stack temperatures to reduce pollution were emphasized.



R. B. LEA, MEMBER ASME, OF THE SPERRY CORPORATION, VICE-CHAIRMAN OF THE ASME HEAVY-PRESS PROGRAM, EXAMINES A MAIN STRUT SUPPORT FORGED ON THE 6000-TON PRESS AT THE ALUMINUM COMPANY OF AMERICA CLEVELAND PLANT

HEAVY-PRESS MODELS EXHIBITED DURING ANNUAL MEETING DRAW ENTHUSIASTIC SPECTATORS

It was reported also that the ASME code on dust separators described several devices by which stacks could be sampled for gases and dust. These methods must be augmented by special techniques for the wide variety of air contaminants now holding public interest. Special filters for capturing dusts and fumes, which enable investigators to capture particles smaller than 1/25,000 in., are now available.

The legal aspects of air-pollution abatement were considered and education of the public on air-pollution problems by every special means was deemed necessary to bring about harmony between industry and surrounding communities.

ATOMIC POWER

For those engineers interested in obtaining useful power from the atom, the Heat Transfer Division presented reports on a liquid-metal heat-transfer and steam-generation system for a nuclear power plant and also on the design and performance of liquid-metal heat exchangers. In addition, the Hydraulic Division discussed electromagnetic and mechanical pumps for high-temperature liquid metals for use in atomic plants. Some of these pumps, which must be leakless and highly dependable, were described.

AUTOMATION

Automation, a subject which is stirring the imagination of many of our engineers, was discussed at joint sessions of the Management, IIRD, Materials Handling, Safety, and Production Engineering Divisions, and the Junior Committee. Progress in automatic production, the future of automatic machinery, material transfer between steps in an automatic process, the application of analog computers and similar equipment to process-control problems, and control problems in an automatic chemical or petroleum plant, were covered. Ultimate automation was defined as the uninterrupted manufacture of acceptable products without human intervention. It was pointed out that automation shows to its greatest advantage where the quality requirements of the end product are tight—

LIEUT. GENERAL JOSEPH SMITH, USAF, COMMANDING GENERAL OF MATS, TELLS OF THE JOB BEING PLAYED BY THE MILITARY AIR TRANSPORT SERVICE AT FOURTH ANNUAL AIR-CARGO DAY PROGRAM AS CAPT. JOSEPH I. TAYLOR, USN, FLEET LOGISTIC AIR WING, PATUXENT RIVER, MD., LOOKS ON

whether in size, weight, finish, or other properties. However, it was emphasized, management still needs to be convinced that automation is economically sound and that it is possible.

VARIETY OF OTHER TECHNICAL MATERIAL

A wealth of other technical material was scheduled during the meeting—far too great to review in the limited space available at this time—but briefly the program included symposiums and panel discussions on heat exchangers and materials problems in heat-exchanger design, turbocharging for Diesel engines, quick-starting of boilers and turbines, the 1952 ASME 10-year Progress-in-Management report, the application of shaft seals to centrifugal and axial-flow compressors, lubrication of lead-babbitt bearings, industry's stake in the secondary school, evolution of the accuracy of the coefficient of discharge in the basic flow-measurement equation, central-station construction costs, and industrial power-plant costs. In addition, papers covered new developments and research in applied mechanics, gas-turbine power, process industries, railroads, cutting fluids, metal cutting, high-temperature steam generation, effect of temperature on metals, furnace performance factors, boiler feedwater studies, wood industries, rubber and plastics, and textile engineering.

Pages 80–82 contain a list of preprints that were made available at the Meeting. The list is arranged according to divisions and committees. In the ASME Technical Digest section of this issue of MECHANICAL ENGINEERING, 49 digests of Annual Meeting preprints appear. Digests of any remaining Annual Meeting preprints will be published in the ASME Technical Digest section of forthcoming issues of MECHANICAL ENGINEERING.

AMERICAN ROCKET SOCIETY

The American Rocket Society, which again held its meeting jointly with ASME, scheduled 21 technical papers at five sessions. ARS headquarters were in the Hotel McAlpin. The program included such topics as combustion studies in rocket motors, escape and survival in space travel, the establishment of large satellites by means of small orbital carriers, application of the ramjet to aircraft propulsion, telemetry instrumentation for rocket test flights, design of liquid-propellant booster rockets, and the ignition of fuel with nitric acid.

INSPECTION TRIPS

Many interesting inspection trips were scheduled during Annual Meeting week. On Monday, December 1, ASME members and guests enjoyed an interesting visit to the Long Lines Division of the American Telephone and Telegraph Company, New York, N. Y. Here they saw the overseas service room, the overseas control office, radio and television control rooms, radio relay and coaxial cables, and demonstrations of equipment.

The next day members and guests toured the International Smelting and Refining Company, a copper refinery in Perth Amboy, N. J. This plant treats crude or blister copper from both domestic and foreign sources. The process consists of melting and furnace-refining the blister, casting it into anodes which are corroded to produce electrolytically refined copper cathodes. These latter are then furnace-refined and cast into shapes such as wire bars, cakes, and billets. By-products such as gold, silver, selenium, and tellurium are recovered during the refining operation.

In the afternoon the Lamp Division of the Westinghouse Electric Manufacturing Company in Bloomfield, N. J., was visited. Most of this tour was spent in the Tungsten Refining Factory, where the raw material to the finished coils for lamp parts was inspected. Visitors also saw the coil winding under magnifying glass and the actual lamp manufacturing.

On Wednesday, December 3, a visit to the field operations office, Transcontinental Gas Pipe Line Corporation, Linden, N. J., was arranged. Members and guests were shown how the various field-operation groups of the pipe-line system operated. This included the gas-control department, responsible for scheduling and regulating the volume and pressure of natural gas delivered to customers in three states, the communications department, which services and checks both microwave and mobile radio instruments, and the pipe-line maintenance department.

Wednesday afternoon one trip was scheduled to the repair and inspection shops of the Independent Subway System of the

ALEX ZEITLIN OF LOEWY CONSTRUCTION COMPANY AND HYDROPRESS CORPORATION USES LARGE-SIZE PHOTOGRAPHS OF 50,000-TON HYDRAULIC DIE-FORGING PRESS TO DEMONSTRATE POINTS UNDER DISCUSSION

City of New York, where the major overhauling and repair work, both mechanical and electrical, is done on subway cars.

The New York Naval Shipyard, Brooklyn, N. Y., played host to an ASME group on Thursday, December 4. This tour acquainted visitors with the Navy's Aircraft Carrier Conversion Program. They saw the development of the aircraft carrier of World War II (CV) Type, to the modern attack carrier (CVA) Type of today.

The last inspection trip of the meeting consisted of a visit to the Brooklyn-Battery Tunnel, Brooklyn, N. Y. Visitors saw the Brooklyn Ventilation Building and the control system in the Brooklyn Administration Building, containing the exhaust and the blower fans which control the supply of air to the east end of the Brooklyn-Battery Tunnel. They also saw the communication and alarm systems.

COLLEGE REUNIONS

This year ten colleges and universities took advantage of the gathering of mechanical engineers from all over the country for the ASME Annual Meeting and scheduled reunions for former graduates. The reunions, consisting in most cases of luncheon and dinner meetings, were held in clubs and restaurants all over the city. Some schools held informal gatherings at nearby eating places, while others held more formal meetings with a speaker on the program. The following schools held reunions: University of California, Carnegie Institute of Technology, The Cooper Union, Cornell University, Georgia Institute of Technology, Johns Hopkins University, University of Michigan, University of Missouri, Rensselaer Polytechnic Institute, and Stevens Institute of Technology.

COMMITTEES IN CHARGE

Meetings of The American Society of Mechanical Engineers come under the general supervision of the Meetings Committee. The technical program is provided by the Society's professional divisions and technical committees. Other features are planned and supervised by committees organized within the host Section—in this case the Metropolitan Section. In grateful acknowledgment of the many committees whose efforts contributed so substantially to the success of the 1952 Annual Meeting their personnel is listed in what follows:

Meetings Committee: Allen W. Thorson, chairman; Robert W. Bacon, Roland W. Flynn, J. Keith Louden, Willis F. Thompson, Glenn R. Fryling, and Harvey D. Moll.

Board on Honors: Warner Seely, chairman; L. J. Cucullu, P. E. Holden, J. B. Ennis, E. L. Hopping, and R. M. Van Duzer, Jr.

Medals Committee: Warner Seely, chairman; L. M. K. Boelter, Ralph D. Brizzolara, Lionel J. Cucullu, Burnham Finney, Paul E. Holden, Ernest L. Hopping, J. Stanley Morehouse, Lester F. Nenninger, Gerald V. Williamson, Alfred V. Iddles, Frank Prouty, C. Richard Soderberg, Joseph B. Ennis, Arthur E. Grunert, H. Drake Harkins, Clifford H. Shumaker, Theodore H. Beard, Eugene Caldwell, Newton C. Ebaugh, and Robert M. Van Duzer, Jr.

Annual Banquet Committee: W. L. Betts, chairman; J. T. Costigan, vice-chairman; J. T. Robinson, E. S. Rowell, and U. A. Rothermel.

Senior Ushers: R. W. Cockerell, R. O. Bailey, F. L. Bradley, W. H. Bryne, A. T. Kniffen, A. R. Mayo, and J. A. McCain.

Junior Ushers: R. E. Weber, chairman junior ushers; E. L. Badwick, J. F. Burns, R. S. Chase, T. J. Dunn, E. S. Guttman, H. Hill, B. K. Ledgerwood, F. J. O'Connor, J. O'Toole, A. Ovris, R. W. Precious, D. R. Riley, H. J. Scagnelli, R. W. Schubert; and J. M. Zablotski.

Committee on Women's Activities: Mrs. U. A. Rothermel, chairman; Mrs. John C. Gibb, Mrs. Robert Cockrell, Mrs. T. A. Burdick, Mrs. Clarence H. Kent, Mrs. H. R. Kessler, and Mrs. Robert B. Skinner.

Committee on Student Aides: Jerome Bartels, H. Russell Beatty, Fred P. Burns, C. R. G. Dougherty, Floyd Hasselriis, Edward Miller, Gordon B. McKay, Walter J. Norton, Fred H. Posser, Ecrole Rosa, John R. White, and Samuel C. Williams.

Inspection Trips Committee: M. O. England, R. W. Flynn, A. T. Kniffen, and G. W. Nigh.

Twentieth National Power and Mechanical Engineering Exposition Advisory Committee: Irving E. Moultrop, chairman, consulting engineer; John H. Lawrence, vice-chairman, consulting engineer; R. H. Bacon, chairman, Meetings Committee, The American Society of Mechanical Engineers; C. E. Davies, secretary, The American Society of Mechanical Engineers; Hugh L. Dryden, chairman, Board on Technology, The American Society of Mechanical Engineers; Chester R. Earle, Managing Editor, *Power Engineering;* Kilshaw M. Irwin, vice-president in charge of engineering, Philadelphia Electric Company; David Moffat Myers, consulting engineer; George A. Orrok, Boston Edison Company; R. J. S. Pigott, President, The American Society of Mechanical Engineers; Joseph Pope, vice-president, Stone and Webster Engineering Corp.; T. E. Purcell, director at large, The American Society of Mechanical Engineers; C. J. Sibler, chief engineer, West Virginia Pulp and Paper Company; Edward Simons, president, American Society of Refrigerating Engineers; A. Bowman Snavely, chief engineer, Hershey Chocolate Corp.; Philip W. Swain, editor, *Power;* and Ernest Szekely, president, American Society of Heating and Ventilating Engineers.

POWER SHOW

Applications in every going industry were included in the scope of the 20th National Exposition of Power and Mechanical Engineering, which was held in Grand Central Palace, New York, N. Y., Dec. 1 to 6, 1952, under the auspices of The American Society of Mechanical Engineers. The event coincided with the 1952 ASME Annual Meeting, and many of the exhibits at the show exemplified subjects under discussion by the engineers.

The exposition covered all branches of the field of power from the conversion of energy into fluid forms, such as heat, light, flowing water, and steam, as well as hot, cold, and compressed air, to its application in moving mechanisms. It included the conversion processes themselves, such as the combustion of fuels, generation of electricity, and the operation of heat exchangers, pumps, and blowers; distribution in transmission lines and pipe lines, including the many applications within the industrial plant, through wires, piping, shafting, and belts, whether or not it generates its own power or buys it from a public utility.

Exhibitors numbered more than 300 and occupied three floors of the Palace. Many were specialists who confined themselves to a single type of product, while others staged displays in which a dozen or more different associated products were incorporated.

Major exhibit classifications included: Power-plant equipment, power-transmission equipment, electrical, heating and ventilating, and air-conditioning equipment; materials-handling equipment, safety, building construction, plant maintenance, and equipment for research and testing. The classified list included 350 items ranging from abrasives, acid-resisting materials, and accumulators, through boilers, condensers, drives, driers, and ducts, to winches, woodworking machinery, and wrenches.

ASME HONORS ENGINEERS

Biographies of Recipients of Honorary Membership and Awards at the 1952 ASME Annual Meeting

EVERY year The American Society of Mechanical Engineers honors distinguished members of the engineering profession by the presentation of certificates of honorary membership and the prizes and awards that have been instituted from time to time during the course of the Society's existence. The bestowal of these certificates, prizes, and awards is a colorful feature of the ASME Annual Dinner where the attendance this year exceeded 1600 persons. A description of the dinner and a list of the recipients of honorary-membership certificates, prizes, and awards will be found on other pages of this issue. In the following pages brief biographies are presented so that members of the Society may know what manner of men they have honored.

HONORARY MEMBERS

JOHN M. LESSELLS

"For outstanding contributions to the development of Applied Mechanics within The American Society of Mechanical Engineers . . ." JOHN MOYES LESSELLS is given honorary membership in the ASME, to which he has belonged since 1923.

Mr. Lessells was born in Scotland in 1888 and was educated in that country, receiving a BS degree in engineering from the University of Glasgow in 1915. During World War I he was connected with the British War Office, Armstrong-Whitworth & Company, and Rolls-Royce Limited.

After the war Mr. Lessells came to the United States and was employed by the Westinghouse Electric & Manufacturing Company. He organized the Mechanics Division of the Research Laboratories at East Pittsburgh and under his direction valuable research work was carried on, the findings being made available in papers published by him and his associates. In 1931 he was made manager of engineering at the Steam Turbine and Diesel Engine Works in South Philadelphia, and here, too, new methods of design and research were initiated and men of outstanding ability were attracted to serve with him in the work.

Mr. Lessells left Westinghouse in 1935 and since then has divided his interests between teaching and consulting activities. He is associate professor of mechanical engineering at the Massachusetts Institute of Technology and president of Lessells and Associates, Inc., Boston, Mass.

He was one of the small group of men who were instrumental in founding the ASME Applied Mechanics Division and he has been one of its chief supporters. To his credit, in particular, is the high standing of the *Journal of Applied Mechanics*, which he has served as editor, without pay, since it was instituted. He is also a member of the Managing Committee of the more recently established *Applied Mechanics Reviews*.

Among the societies of which Mr. Lessells is a member are The Institution of Mechanical Engineers, from which he has received the Bernard Hall Prize, and The Franklin Institute, which gave him the Levy Medal.

STEPHEN P. TIMOSHENKO

"Internationally known educator, eminent scientist and engineer, world authority in the field of applied mechanics, author of a score of books . . . ." So runs the citation conferring honorary membership upon STEPHEN PROKOP TIMOSHENKO. He, too, was a participant in establishing the Applied Mechanics Division and the *Journal of Applied Mechanics*, to which he has been a frequent contributor.

Dr. Timoshenko was born near Kiev, Russia, in 1878. He obtained his engineering education at the Institute of Ways of Communication, St. Petersburg, graduating in 1901, and in Germany under such teachers at Föppl and Prandtl. He taught both at his alma mater and at the Polytechnic Institute in St. Petersburg, and at the polytechnic institutes in Kiev and in Zagreb, Yugoslavia, before he came to the United States in 1922 as consulting engineer for the Vibration Specialty Company, Philadelphia, Pa. In 1923 he joined the research staff of the Westinghouse Electric & Manufacturing Company at Pittsburgh, with which he continued until 1927. He also lectured at various universities, and his love for teaching and desire for more time for writing finally led him to leave Westinghouse to become professor of engineering mechanics at the University of Michigan.

Dr. Timoshenko taught at Michigan until 1936, then accepted the chair of professor of theoretical and applied mechanics at Stanford University. Although he officially retired in 1946, he continued to lecture as a part-time professor. He has also kept touch with industry as a consultant to several companies. His writings include about 20 books, some of them published in several languages, and nearly 100 papers.

The honorary DE degree has been given him by both the University of Michigan and Lehigh University. Other honors include the James Watt International Medal, Lamme Medal, and Worcester Reed Warner Medal. He is a member of many scientific and engineering societies in this country and abroad. He joined the ASME in 1924 and was elected a Fellow in 1938.

RECIPIENTS OF MEDALS AND AWARDS

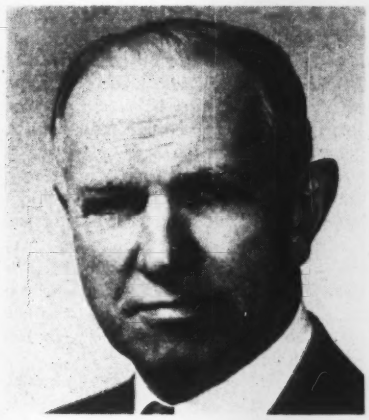
DANIEL GUGGENHEIM MEDAL

"For 40 years of pioneering in military and commercial aircraft and the development of long-range jet transport" the Daniel Guggenheim Medal is given to SIR GEOFFREY DE HAVILLAND. In 1908, when he was 26, he left a position in London, England, as designer in the motor industry to satisfy his desire to build and fly an airplane. His first plane crashed; in the second, summer of 1910, he learned to fly. Shortly afterward he joined the Army Balloon Factory at Farnborough as a designer and pilot.

Early in 1914 he became chief designer and pilot for The Aircraft Manufacturing Company, Ltd., at Hendon. He designed the two-seat pusher biplane fighter and a number of other military aircraft. By 1918 a third of the total Allied air strength comprised planes of the de Havilland design.

In 1920 he founded The de Havilland Aircraft Company, Ltd. The first scheduled international air service, between London and Paris, had been inaugurated with craft of his design in 1919, and thereafter he created a number of airliners for the British Empire services. He also pioneered the light air-

Made Honorary Members of the ASME



JOHN M. LESSELLS
Honorary Membership

STEPHEN P. TIMOSHENKO
Honorary Membership

plane, the *Moth*, which he first flew in 1925. To meet the wide demand for such craft, the company became engine manufacturers in 1927. In 1935 Sir Geoffrey introduced the manufacture of variable-pitch propellers in Great Britain.

World War II led de Havilland again into the military field and to the conception of the *Mosquito* combat plane. Early in 1942 the company also had its *Goblin* jet engine running on test. Since the war the first jet airliner, the *Comet*, has been introduced.

Sir Geoffrey is a Fellow of the Royal Aeronautical Society and an Honorary Fellow of the Institute of the Aeronautical Sciences. He received the Air Force Cross for his services to military aviation, was made a Commander of the Order of the British Empire in 1934, and was knighted in 1944.

ALFRED NOBLE PRIZE

"Intermittent Heating for Aircraft Ice Protection With Application to Propellers and Jet Engines" is the title of the paper for which MYRON TRIBUS has won the Alfred Noble Prize. It was published in ASME Transactions, November, 1951.

A Californian by birth—San Francisco, 1921—Dr. Tribus received a BS degree in chemistry from the University of California in 1942 and a PhD in engineering in 1950. He was elected to Sigma Xi and Phi Beta Kappa.

His work has centered on research in the aeronautical industry, chiefly on aircraft heat transfer and airplane icing. During his senior year he was research assistant on a program sponsored by the National Advisory Committee for Aeronautics at the university, and following his graduation, on leave of absence from the faculty, he spent four years in the U.S. Air Force, Air Materiel Command, at Wright Field, rising to the rank of captain, in charge of airplane icing research.

From 1946 to 1950 he taught at the University of California, becoming assistant professor of engineering, and also took part in aeronautical-research programs. Subsequently he was associated with the General Electric Company in its aircraft gas-turbine and aircraft nuclear-propulsion divisions. In 1951 he took his present position of director of icing research at the University of Michigan's Engineering Research Institute; he is also visiting assistant professor of chemical engineering. He continues to serve the General Electric Company as consultant on nuclear heat transfer.

Dr. Tribus is a junior member (1944) of the ASME and also belongs to the Institute of the Aeronautical Sciences and the American Society for Engineering Education.

In addition to his reports for the NACA, Air Force, and Engineering Research Institute, Dr. Tribus is coauthor of a textbook on "Elementary Heat Transfer" and has written several papers which have been published by the Society of Automotive Engineers, Institute of the Aeronautical Sciences, and ASME. In 1945 the SAE awarded him the Wright Brothers Medal and the IAS gave him the Thurman H. Bane Award.

ASME MEDAL 1952

The ASME Medal, established by the Society in 1920, is presented for distinguished service in engineering and science. It is awarded to NEVIN ELWELL FUNK "for pioneering achievements in economic operation of interconnected power systems."

His distinguished contributions to the electric-power industry were made during an association of more than 40 years with the Philadelphia Electric Company. Following his original employment in 1907 as assistant foreman of the station electrical construction department, he held various positions in the operating and engineering departments leading to his appointment as vice-president in charge of engineering in 1929, at which time he also became vice-president and director of a number of the company's subsidiaries. From 1947 until he retired in 1950 to engage in consulting work, he was its executive vice-president and director.

Born in Bloomsburg, Pa., in 1883, he received an EE degree from Lehigh University in 1905 and the DE degree in 1943. Prior to his connection with the Philadelphia Electric Company, Dr. Funk served an apprenticeship course with the

Westinghouse Electric & Manufacturing Company, was employed by the New York Central Railroad in connection with equipping the first multiple-unit cars of that road, and was assistant professor in charge of the mechanical and electrical laboratory at the Georgia School of Technology.

A number of engineering societies, including the American Institute of Electrical Engineers, The Franklin Institute, and the National Electric Light Association, have benefited by Dr. Funk's services as officer and committee member. In the ASME, the Philadelphia Section, the Power Division, and many committees have had his untiring support. He joined the Society in 1913, became a Fellow in 1939, and served as vice-president, Region III, 1946–1947. He has made many noteworthy contributions to engineering literature, and has been active on local, state, and federal government bodies.

HOLLEY MEDAL

The Holley Medal was instituted and endowed in 1924 by George I. Rockwood, past vice-president of the Society, to be bestowed for some great and unique act of genius of engineering nature that has accomplished a great and timely public benefit.

Of the many people who demand "Sanforized" products, all may not know that the term derives from the name of the inventor of the process. The mechanical shrinking of textile fabrics was pioneered by SANFORD LOCKWOOD CLUETT more than 20 years ago, when little was known of the plastic properties of textiles.

Many other inventions are to Dr. Cluett's credit, including a chronograph, lock gates and valves for locks, and harvesting machinery.

Dr. Cluett has spent much of his life in Troy, N. Y., where he was born in 1874, and in nearby Hoosick Falls. He was graduated with honors from Rensselaer Polytechnic Institute in 189. as a civil engineer. Following two years in the U. S. Engineer's Office, Louisa, Ky., he was connected with the Walter A. Wood Mowing & Reaping Machine Company, Hoosick Falls, from 1901 to 1919, serving as vice-president and director in charge of plant operations from 1907. After becoming a member of Cluett, Peabody & Company, Inc., Troy, in 1919, he had charge of various departments; he has served as a director since 1921 and vice-president since 1927.

Dr. Cluett has a military record with the National Guard of New York and the U. S. Volunteer Engineers dating from 1897. He resigned as Major, Signal Corps, NGNY, in 1921.

Among honors conferred upon him are the Modern Pioneer Award, National Association of Manufacturers, 1940; Longstreth Medal, The Franklin Institute, 1945; and honorary doctor of engineering degree, Rensselaer Polytechnic Institute, 1952. His memberships include the U. S. Naval Institute, Society of American Military Engineers, Army Ordnance Association, The Franklin Institute, U. S. Institute for Textile Research, Sigma Xi, and the ASME, which he joined in 1903.

WORCESTER REED WARNER MEDAL

The Worcester Reed Warner Medal, established in 1930, provision for which was made in the will of Worcester Reed Warner, Honorary Member of the Society, is bestowed for outstanding contributions to permanent engineering literature.

Born in Germany in 1879, MAX JAKOB received degrees in electrical engineering and applied physics from the Royal Institute of Technology, Munich, and went on to get his doctor's degree there in 1904.

In 1910, after a few years with German and Swiss manufacturing companies, he became affiliated with Germany's National Institute of Applied Physics (Physikalische-Technische Reichsanstalt) in Berlin. Appointed professor and senior government adviser in 1914, he directed laboratory research in applied thermodynamics, heat transfer, and fluid flow until 1935. He was also (1910–1934) scientific adviser, member of the editorial staff, and chairman of the committee on heat research of Verein deutscher Ingenieure. In 1930 he founded the journal *Forschung auf dem Gebiete des Ingenieurwesens*, covering engineering research, and he served as its editor for three years. During the next six years he collaborated with A. Euchen in the monumental work "Der Chemie-ingenieur."

Dr. Jakob came to the United States in 1935 and was guest lecturer at several universities prior to becoming research professor of mechanical engineering and director of the Heat Transfer Laboratory of the Illinois Institute of Technology in 1937. His membership in the ASME also dates from that year. He was nonresident research professor of heat transfer at Purdue University, 1944–1949, and has since been its consultant in that subject. The University conferred the honorary DE degree upon him in 1948.

Both German and English technical literature have been immensely enriched by the writings of Max Jakob. To an impressive list (prepared a few years ago) of more than four hundred publications—books, articles, discussions, and reviews—he is continually adding other works.

MELVILLE PRIZE MEDAL FOR ORIGINAL WORK

The Melville Prize Medal for original work, established in 1914 by the bequest of Rear Admiral George W. Melville, Honorary Member and past-president of the Society, is presented for an original paper or thesis of exceptional merit, presented to the Society for discussion and publication, to encourage excellence in papers.

NEIL PHILLIPS BAILEY's Melville Award paper, "Flow and Combustion Stability," is one of a number of articles written by him since 1928, along with several textbooks and contributions to Kent's "Mechanical Engineers' Handbook."

Born in Canon City, Colo., in 1900, Professor Bailey served for about a year in the U. S. Marine Corps in 1918-1919. Therefore he did not obtain his BS degree in mechanical engineering at the University of Colorado until 1924. He then took the General Electric Company's test and advanced engineering courses. From 1925 to 1929 he was engaged in teaching in the mechanical-engineering department at the University of Idaho, where he received his MS degree in mechanical engineering in 1927. During summer vacations he did plant-design work for the Washington Water Power Company, Spokane.

Since 1929 Professor Bailey has taught mechanical engineering successively at the University of North Carolina until 1934, Iowa State College, 1934-1935, Rutgers University to 1942, and Rensselaer Polytechnic Institute since 1944. He is Russell Sage Professor of Mechanical Engineering and head of the department at Rensselaer. He engaged in mechanical-engineering research on flow and combustion for the General Electric Company, 1942-1944.

Elected a junior member of the ASME in 1924, Professor Bailey rose to the grade of Fellow in 1950. He belongs to the American Society for Engineering Education and to Sigma Xi, Tau Beta Pi, Sigma Tau, and Pi Tau Sigma.

Professor Bailey reports that two brothers, two brothers-in-law, one son-in-law, and two sons are mechanical engineers.

JUNIOR AWARD

The Junior Award, established in 1914, from a fund created by Henry Hess, past vice-president of the Society, is presented

Recipients of Medals and Awards

NEVIN E. FUNK
ASME Medal

MAX JAKOB
Warner Medal

SANFORD L. CLUETT
Holley Medal

WARREN M. ROHSENOW
Junior Award

JESS H. DAVIS
Richards Award

NEIL P. BAILEY
Melville Medal

for the best paper or thesis submitted by a junior member.

WARREN MAX ROHSENOW, associate professor of mechanical engineering at the Massachusetts Institute of Technology, has made important contributions to the development of methods of teaching and to laboratory activities there. He has created a worth-while graduate subject, advanced heat transfer, and has supervised a long list of theses on the subject.

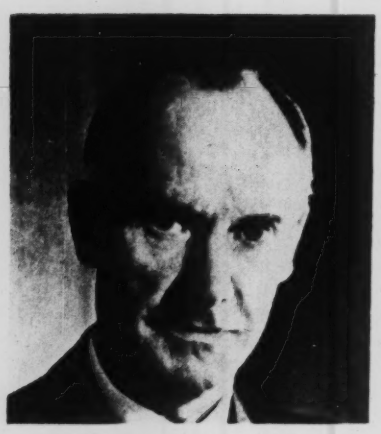
His Junior Award paper, "A Method of Correlating Heat Transfer Data for Surface Boiling of Liquids," published in the ASME Transactions, August, 1952, follows others on heat transfer, temperature measurements, and gas turbines of which he has been author or coauthor.

He was born in Chicago in 1921 and after taking his BSME degree at Northwestern University in 1941, he continued his studies at Yale University, winning an ME degree in 1943 and a DE in 1944.

In 1943-1944 he was active on the National Defense Research Committee's Columbia University project on torpedoes and then until 1946 he served as lieutenant (j.g.) in the U. S. Naval Reserve, on active duty at the U. S. Naval Engineering Experiment Station at Annapolis, working with the gas-turbine group on performance and test of gas turbines. He is still a consultant in this work.

Dr. Rohsenow has engaged in consulting practice in heat

Recipients of Medals and Awards



SIR GEOFFREY DE HAVILLAND
Daniel Guggenheim Medal

MYRON TRIBUS
Alfred Noble Prize

HUBBERT L. O'BRIEN
Pi Tau Sigma Medal

ISRAEL E. RUBIN
Charles T. Main Award

GEORGE L. STOCKING
Undergraduate Student Award

transfer, fluid flow, and gas turbines for a number of industrial companies and government agencies and is currently active as a consultant for the Carbide Carbon Chemicals Division at Oak Ridge, Tenn.

His impressive record in teaching and in research brought him the 1951 Pi Tau Sigma Medal and the 1952 Award for Advancement of Basic and Applied Science of the Yale Engineering Association.

A junior member of the ASME since 1941, Dr. Rohsenow is taking an active part in committee service in the Heat Transfer Division.

PI TAU SIGMA RICHARDS MEMORIAL AWARD

The Richards Memorial Award, established in 1944, endowed by Pi Tau Sigma, national honorary mechanical-engineering fraternity, is presented for outstanding achievement in mechanical engineering within 20 to 25 years after graduation from a regular four-year mechanical-engineering course of a recognized American college or university.

Graduated from The Ohio State University in 1928, inaugurated president of Stevens Institute of Technology in 1951—such is the over-all record which brings JESS HARRISON DAVIS the Richards Memorial Award.

Succeeding Dr. Harvey N. Davis (no relation), the fourth

president of Stevens, Dr. Davis is a young man to have won this high place. He was born in 1906 in Columbus, Ohio. To his BME degree of 1928 he added an MS degree at Ohio State five years later, and in 1949 he received the DS degree from St. Lawrence University.

As an educator, Dr. Davis began his career at Clarkson College of Technology in 1929. By 1940 he had become full professor of heat-power and experimental engineering. During a two-year interval (1944-1946) in his association with Clarkson, he was professor and head of the department of mechanical engineering at the Speed Scientific School, University of Louisville. He was recalled to Clarkson as dean of administration, became acting president in 1947, and was president of the college from 1948 to 1951.

In industry, too, Dr. Davis has seen considerable experience as mechanical and consulting engineer for a number of companies. He is on the board of directors of the Niagara Mohawk Power Corporation and was recently appointed a commissioner of the Port of New York Authority.

Dr. Davis has been active in ASME section and committee work for some years. Other society memberships include the American Society for Engineering Education and American Society for Testing Materials. He is a member of Tau Beta Pi and Pi Mu Epsilon.

PI TAU SIGMA GOLD MEDAL AWARD

The Pi Tau Sigma Gold Medal Award, established in 1938, endowed by Pi Tau Sigma, national honorary mechanical-engineering fraternity, is presented for outstanding achievement in mechanical engineering within ten years after graduation from a regular four-year mechanical-engineering course of a recognized American college or university.

HUBBERT LIGUORI O'BRIEN obtained his BS degree in mechanical engineering from Purdue University in 1946 and his MS degree the following year. Born at Spartanburg, S.C., in 1924, he studied at the Baltimore Polytechnic Institute and spent a year each at the University of North Carolina and Duke University before entering Purdue. He also served in the U. S. Marine Corps, 1943-1946. At Purdue he held a Standard Oil Company (Indiana) research fellowship, and his research on pressure vessels was presented in his thesis on "Method and Technique for Calibrating the SR-4 Strain Gages Subject to Hydrostatic Pressure." He also taught applied mechanics at the University in 1946-1947.

The following summer Mr. O'Brien worked on pressure-vessel design for E. B. Badger & Company, Boston, Mass. Then he returned to Purdue as engineer in connection with a pressure-vessel research project and as instructor in the school of civil engineering. Since 1949 he has been associated with the Graver Tank & Manufacturing Company, Inc., East Chicago, Ind., where his duties have included both research and product management in connection with petroleum-conservation equipment.

Mr. O'Brien has belonged to the ASME since 1946 and has served on the Boiler Code Subcommittee on Strength of Vessels Under External Pressure. He is also active in the National Association of Corrosion Engineers. Several technical papers by him have been published by the ASME and elsewhere. His attainments in research won him election to Sigma Xi.

CHARLES T. MAIN AWARD

This award was established in 1919 from a fund created by Charles T. Main, past-president of the Society, to be awarded for the best paper within the general subject of the influence of the profession upon public life. The exact subject is assigned annually.

A student at the Cooper Union School of Engineering, ISRAEL ELI RUBIN, has won the award for his paper, "Engineering as a General Education." Born in Haifa, Palestine, in 1932, Mr. Rubin came to the United States in 1939.

Evening classes for three years at the Hebrew High School of Greater New York and a four-year college preparatory course at the Brooklyn Technical High School preceded his entrance to Cooper Union in September, 1950, as a student of mechanical engineering. He was awarded the Emil Schweinburg Scholarship, and at the end of his second year he received the Gold Medal for excellence in calculus.

Both in high school and in college Mr. Rubin has engaged rather heavily in extracurricular activities and has even managed to work part time as a printing salesman, all without detriment to his schoolwork. He has received the Lambda Tau Key for service as advertising manager of the Cooper Union newspaper, *Pioneer*. He is business manager of the school's year-book, *Cable*, as well as business manager of the *Literary-Arts Magazine* and the newspaper of his fraternity, Alpha Mu Sigma, of which he is also secretary. He is a member of the Fine Arts Committee of the Humanities Club, and a student member of the ASME.

Mr. Rubin has had three months' practical experience in design work in the electromechanical design division of the New York Naval Shipyard. He is much interested in administrative engineering and contemplates postgraduate work in that subject.

UNDERGRADUATE STUDENT AWARD

Two Student Awards, established in 1914 from a fund created by Henry Hess, past vice-president of the Society, are presented for the best papers or theses submitted by Student Members. The postgraduate award is not being made this year.

The winner of the undergraduate award is GEORGE LANE STOCKING, who received his BSME degree from Iowa State College, Ames, in June, 1952. His paper is titled "High-Temperature Electrical Resistance Strain Gages."

Mr. Stocking was born at Omaha, Neb., in 1927 and received his early education there, preparing for college at the Creighton University High School. In April, 1945, however, he joined the U. S. Navy, and upon completion of his training was stationed at Norfolk, Va., for a time and then saw service in Philippine waters from October, 1946, to December, 1947, when he was discharged.

He entered Iowa State College in September, 1948. He was regimental colonel of the Army Reserve Officers Training Corps, and during his last two years he assisted in metallurgical research in the Ames Laboratory of the Atomic Energy Commission. A paper by him on "Turbine Transports" was published in the *Iowa Engineer* in 1951.

Mr. Stocking was secretary of the ASME student-member group at Iowa State in 1951-1952. He was also a student member of the Society of American Military Engineers. He was elected to Pi Tau Sigma in 1950 and to Tau Beta Pi in 1951. He was steward of the Phi Gamma Delta fraternity.

At present Mr. Stocking is employed in the engineering division of the Procter & Gamble Company in Cincinnati, Ohio. He is connected with the factory-equipment section, technical service department, and is concerned with the coordination of activities between the engineering division and the 13 factories of the company located throughout the United States.

The Charles T. Main Award and the Undergraduate Student Award were presented at the Members and Students Luncheon, Thursday, December 4.

ASME 1952 ANNUAL MEETING PREPRINTS

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COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Waste-Heat Boilers

COMMENT BY LEROY FREWIN[1]

Heat Recovery. As a user of waste-heat boilers it is felt the problem of heat recovery has been covered in a general manner in this paper.[2] A paper devoted exclusively to this subject would be welcomed by users of waste-heat boilers.

Heat transfer in water wall, screen tubes, superheater, and convection surface appears quite complex. In spite of recent publications on heat transfer the determination of *U*-coefficients and corresponding mean temperature differences remains quite difficult.

A need for the rationalizing and publishing of existing data on heat transfer in waste-heat boilers exists. If the manufacturers would take the lead in this work it would advance the art and stimulate boiler users in the collection and publication of supporting information.

In spite of the many papers on heat transfer the writer is not acquainted with any information or collection of information making design of heat-transfer surface in waste-heat boilers convenient, fast, or accurate.

In the past few years many apparently attractive waste-heat-recovery applications have failed to be economically sound. This failure is a result of lack of ingenuity on the part of customer and manufacturer in arranging properly the heat-transfer surface. This ineffective arrangement of heat-transfer surface greatly increases the cost and space requirements, making waste-heat installation economically unattractive when compared with other sources of energy.

As a user of waste-heat boilers we look forward to future presentation of detail methods of estimating *U*-values of various types of waste-heat boiler surface and methods of allowing for surface "fouling" on specific types of applications.

Types of Boilers. The design of waste-heat boilers for heat recovery from contaminated gases could easily serve as the subject of an entire paper. Many installations of waste-heat boilers handling contaminated gases have been made, but they have been only partially successful.

Some of the factors contributing to these difficulties are as follows:

1 Boiler must fit existing buildings or equipment.

2 Low softening or plastic temperature of dust in flue products (1600 to 1700 F and even less).

3 Sulphur and other elements and their compounds causing high-temperature corrosion of pressure parts and boiler casings. (In regions of gas temperature as high as 2000 F.)

These factors combined have resulted in waste-heat boilers of moderate success. Tube fouling with accompanying increase in pressure loss and decrease in heat recovery have imposed restrictions on co-ordinated processes, causing skepticism on part of management and operators of process equipment toward installation of waste-heat boilers.

There is a constant fear that boilers will interfere with process requirements and reduce production. In many cases production has been reduced.

Waste-heat boilers for contaminated-gas service have in many cases cost too much because of ineffective use of heating surface. Poor heating-surface arrangements and lack of effective methods of lowering temperature of gas-carried dusts below the plastic stage have made boiler costs unreasonably high. In several cases up to 100 per cent more radiant surface has been installed than apparently was required, yet temperatures were not reduced enough to prevent fouling of the boiler surface.

To alleviate the failure of waste-heat boilers to reduce gas temperature to a suitable value before impingement of screen tubes spaced at about 12 in. centers several expedients have been used as follows:

1 Puff or mass-type retractable soot blowers.

2 Air-water hand lancing.

3 Air hand lancing.

4 Water sprays.

5 Recirculation of combustion gases.

The foregoing expedients are not desirable and they are expensive but they have been found necessary to insure continuity of operation for periods up to 18 months to make the boiler operation as reliable as the related and associated process equipment.

In some of our more difficult installations as high as 24 per cent of the steam generated has been used to clean boiler surfaces either directly in soot blowers or as power to air compressors. Even these large supplementary applications of energy were not entirely successful in keeping boiler surfaces clean.

It is felt that great strides have been made in waste-heat boiler design and application in the past 25 years. The surface has only been scratched, however. Future improvements will be the result of ingenuity on the part of users and builders of waste-heat boilers. Co-operation between users and builders and sharing of data reduced to form convenient for design use are necessary for proper advancement of the art and solution of its problems.

SHORTCOMINGS OF PRESENT DESIGN

In summary, shortcomings of present design are as follows:

1 Ineffective reduction of temperatures before closely spaced tubes.

2 Radiant and convection surfaces are hard to clean.

3 Poor dust removal and disposal methods.

4 Designs are hard to repair and service.

COMMENT BY P. K. RICHARDSON[3]

There are many aspects of waste-heat boiler design which are not covered adequately in the paper. In the design of waste-heat boilers for copper-matting furnaces, the principal problem which confronts the designer is the arrangement of heat surface in such a manner as to permit easy cleaning. This factor is

[1] Power Department, American Smelting and Refining Company, Garfield, Utah. Mem. ASME.

[2] "Design and Application of Waste-Heat Boilers," by Robert Cubberly and K. J. Ray, MECHANICAL ENGINEERING, vol. 74, June, 1952, pp. 480-482.

[3] Power Engineer, American Smelting and Refining Company, Salt Lake City, Utah. Mem. ASME.

paramount because unless accretions can be removed thoroughly and quickly the heat surface fouls up so that a limited heat transfer only is possible and the draft loss soon exceeds the capacity of the induced-draft fan.

Copper-matting furnaces are usually about 120 ft long and 25 ft wide inside. Such a furnace will burn 150,000 to 250,000 cu ft of natural gas per hr, depending upon whether the furnace is fed a calcined charge or concentrates directly. If the furnace is fed calcines, 10 to 15 tons of dust may pass through the furnace every 24 hrs. This material usually is in a molten condition at temperatures above 1700 F. The gases usually enter the waste-heat boiler at about 2400 F. The problem of chilling the molten particles satisfactorily before they enter the closely spaced convection surface is a formidable one, and so far has not been solved successfully for furnaces whose charge contains appreciable amounts of arsenic, lead, or antimony. The oxides of these metals, in combination with other constituents in the charge, form a sticky adherent mass which first must be chilled with water and then barred off the tubes. Recent experimental work indicates that it may be necessary to recirculate up to 30 per cent of the boiler exit gases back through the boilers in order to prevent accretions, and that even with gas recirculation it is sometimes necessary to spray into the boiler entrance flue large quantities of water. This practice is certainly contrary to the generally accepted principles of boiler operation, but has been found necessary on some waste-heat boilers of recent design.

Industry's Last Chance

TO THE EDITOR:

The article, "Industry's Last Chance," in the March, 1952, issue of MECHANICAL ENGINEERING deserves comment. In dealing with the President's Conference on Industrial Safety, Mr. Ainsworth strongly implies that the industrial-accident situation in the country is in a bad state. In his 1200-word article, he fails to quote National Safety Council statistics that clearly show that during the last 30 years there has been a great improvement in large industry's accident frequency, substantially all of which has been accomplished by management and its safety engineers and a real interest on the part of the employees.

In one sentence Mr. Ainsworth says there has been no tendency for governmental control of accident-prevention activities in this country. However, a few paragraphs later he states that industry must supply ASA with "technical material which might be used as a basis for new codes"—new codes for new safety regulations—and the "lack of fulfillment may easily cast the die as to the direction in which government will operate in the future." This surely is the current administration's "American Way of Doing Things," which incidentally is the title of the opening part of his article.

Regulatory people, as well as safety engineers, know that the majority of accidents are caused by human errors that are not correctable by safety codes. Most automobile accidents are caused by taking chances, by errors in driver's judgment, by lack of common road courtesy, and not by some mechanical defect of the car or road. The same basic principle applies to industrial accidents. The majority of accidents are caused by the man who has the accident and not by situations that are correctable by new standards, codes, or laws.

It is true that working conditions in many smaller industrial or like enterprises (where safety engineering is not practiced) contribute to their high accident frequency. The farm and the home are other classic examples. The proper education in the use of existing well-known standards would help to correct this situation. This is the field where safety education and current ASA Standards could be used effectively.

Mr. Ainsworth completely fails to point out where safety work is needed in this country and he fails to recommend what specific safety engineering, education, and enforcement means should be used. It appears that he employs typical bureaucratic evasiveness to support his contentions.

Obviously, management and safety engineers cannot agree with this impractical approach. Industry's special standards relate almost entirely to specific hazards of individual operations and are not applicable to general usage. They are well known within the specific industry. Management does not need to supply a mass of such detail for new recommendations for new codes to lower our national accident toll. There are practical well-established ASA standards available now which, if used properly, will serve a good purpose.

To a great many of the professional safety engineers in the country it appears that the underlying objective of the President's Conference is to establish a new federal bureau, new laws, new inspectors, new fees, new taxes, and new votes merely to add to an already overtaxed, overbureaued government.

JAMES E. HILL.[4]

June 23, 1952

[4] Palos Verdes Estates, Calif.

No Middle Ground?

TO THE EDITOR:

In the August, 1952, issue of MECHANICAL ENGINEERING, there was an article entitled: "Let's Take the Strait Jacket Off Technical Style," by R. L. Shurter. Its author decries the use of the impersonal, formal style that engineers use when writing their reports, and suggests that engineers should start using personal pronouns. Personally, I think this sort of thing has gone too far already.

If this trend toward informality continues—a trend which, in recent years, has been slowly but surely undermining our good old hairy-eared and time-tested mores—then there is no telling where we will wind up. If the fellow who wrote that article had his way, why, I could just picture where, thirty years from now, we will be reading "reports" such as this:

LABORATORY TESTS OF DIFFERENTIAL GRADIENT TRANSDUCER
(From now on called "The Gismo" for short)

Conducted by "Buz" Collins, Roger Beinig, and myself, September, 1982.

1. *Mechanical Construction and Appearance of the "Gismo"*

The Gismo seems to be pretty well constructed. It has sort of a grey finish, and I myself think it looks darn good. "Buz" Collins thinks it looks like an elephant. What a joker that "Buz" is! Always good for a laugh.

2. *Dynamic Performance of Gismo*

When we first tested the Gismo, it didn't work at all, because Roger Beinig had it hooked up wrong. We hooked it up right, but it still didn't work so good, because there was a leak in one of the air lines. By then, it was time to go to lunch, and when we got

back, someone had swiped our air regulator. Conditions in this lab are terrible. By that time, all three of us were pretty well disgusted, and we agreed it wasn't worth all the trouble, and we didn't want to test the dynamic performance anyway.

3. *Static Performance of Gismo*

We were doing pretty well plotting the curve, when suddenly the mercury column blew. I told that Roger not to let the pressure go too high, but he wouldn't listen! Just for that, "Buz" made him scoop all the mercury off the floor all by himself. Serves him right, too. Maybe he'll be more careful the next time. When we had all the mercury back in the column, we finished the tests, but the curve didn't look so good. (See attached graph.) Roger thinks it's because of the dirt in the mercury.

4. *Conclusions and Recommendations*

Under the conditions, we think the Gismo did pretty good. Maybe if we get our regulator back, we'll finish the dynamic performance tests, but then we shouldn't let Roger watch the mercury column. He can take down the data.

"Strait Jacket," my eye!

DAVID W. PESSEN.[5]

[5] Philadelphia, Pa. Jun. ASME.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Quality Control

QUALITY CONTROL AND INDUSTRIAL STATISTICS. By Acheson J. Duncan, Richard D. Irwin, Inc., Chicago, Ill., 1952. Cloth, 5¾ × 9 in., 144 figs., 61 tables, references, appendixes, author and subject indexes, xxvii and 663 pp., $9.

REVIEWED BY H. G. ROMIG[1]

WE have been looking forward to Professor Duncan's book on quality control and after its appearance find it very satisfying. There has been a need for a good textbook that would contain in one volume the necessary subject matter for a good quality-control engineer. To be sure, it does not contain everything many of us would desire in one volume, but the choice of subject matter in this text is excellent. It will doubtless be selected as a text in industries and universities giving courses in quality control.

Distributions, their form, nature, and applications, are presented first. This is the same approach as is used successfully by many industrial courses that have been given during the past ten years. It orients the reader to the basis of the proper evaluation of data.

Tables, wherein the number of defects, the height in inches, and so on, have the larger number at the top and decrease as you go down, tend to confuse. This is the author's choice, but still he is not consistent as cumulative distribution's tables use the customary order. The upper class limit in table 6, page 35, is preceded by a dash, which might readily be suspected to be a minus sign. The unit of measurement (inches) is omitted. Table 4, page 33, gives the same data as a frequency distribution rather than a cumulative distribution and again gives the largest values first and fails, probably purposely, to give the lower boundary. Possibly this approach is wise since it begs the question as to what should be recorded as the boundary—the same value as the succeeding boundary or should one use a value differing by one in the last significant figure, in this case the fourth figure? Engineers would like their texts to make a recommendation since it is necessary to know the cell into which a boundary measurement is to be placed.

The book is remarkably free from errors. On page 60, line 5, fig. 25 should be 26; on page 61, footnote 5, the reference D. Van Nostrand Company, Inc., should be John Wiley & Sons, Inc. On page 73, Theorem VII, third line has X instead of Y and fourth line Y should be X. With this change the written theorem will agree with the formula given. As soon as it is felt that all errors are known, an errata should be issued.

The notation in some cases is not standard. The use of S for lot size and N for sample size is not too good. Many texts use S for the summation symbol. The references are fairly complete. No reference is given to Dean Walter Bartky's work on multiple sampling which appeared in "The Annals of Mathematical Statistics" many years before other papers on sequential sampling. His work goes back to 1928 originally, although unpublished, and may be considered the basis of the continuous and sequential sampling plans discussed in this text, which were developed much later.

The standard form of control charts as presented in the ASTM Manual and the majority of texts, is not used. Using solid rather than dashed lines for the three-sigma control limits is unfortunate. The $\bar{X}$ chart on page 291, fig. 101, is too well controlled to be representative of actual data. Possibly the standard deviation used is too large. It is good that modified control limits are included. They are very useful in many types of problems. Fiducial limits as compared with confidence limits are not covered. These two concepts are, of course, controversial since numerically they are generally identical.

The many tests included are very helpful. The weakness of the F-test needs clarification. Prior tests, covered by H. A. Freeman, known as the L_0 and L_1 tests, are not included, thus leaving a missing gap that needs to be filled. Most texts ignore this point; consequently, fallacious conclusions are reached because no checks are made to determine if the data satisfy the underlying assumptions of the F-test.

The design of experiments section is sketchy but should be considered as a challenge and not complete text material. The analysis of variance and correlation aspects of the current problems are covered lightly but serve as good introductions to these fields. The inclusion of a large number of good problems makes this an excellent text for classroom use. The inclusion of so many useful tables makes this a working handbook as well as a reference text. The excellent glossary of terms is a valuable addition. Placing many of the mathematical proofs in the appendixes makes the book more readable and easier to use as a reference.

Considering the book as a whole it should be classed as excellent; its presentation is clear, concise, and scholarly. Those studying it carefully will find many answers to their problems as it covers the more important phases of our quality-control work. Professor Duncan is to be commended on presenting a work that has been badly needed in American industry.

[1] Quality Manager, Hughes Aircraft Company, Culver City, Calif.

Biography of an Idea

BIOGRAPHY OF AN IDEA: THE STORY OF MUTUAL FIRE AND CASUALTY INSURANCE. By John Bainbridge. Doubleday and Co., Inc. Garden City, N. Y., 1952. Cloth, 5¼ × 8¼ in., plates, index, 381 pp., $4.

REVIEWED BY J. K. FINCH[2]

AT first thought the story of the development of mutual insurance in the United States appears to have little or no possible engineering interest. Yet there can be little doubt that the insurance idea—especially that of mutual insurance—has exercised an important influence on engineering developments in a wide variety of fields from structures and machinery to accident prevention. In fact, among the many engineers who have been directly or less directly involved in improvements which have reduced fire, accident, and other risks one notes that of John R. Freeman (1855–1932), whose reputation as a consulting water-supply and hydraulic engineer placed him in the foremost ranks of American civil engineers, and who served as president of the Manufacturers Mutual Fire Insurance Company for some 36 years. In fact, this unusual dual role led Mr. Freeman to refer to himself as the Dr. Jekyll and Mr. Hyde of the engineering profession.

The present volume, published under the sponsorship of a "Mutual Insurance 200th Anniversary Committee," traces the evolution of the mutual idea in fire and casualty insurance from early days to the present time. Fire insurance appears to have come into being as a result of the great fire of 1666 in London. It was the desire to secure safer and cheaper insurance that led to the first mutual company some 30 years later. Benjamin Franklin, that great organizer of "cooperative efforts in the sphere of liberty," was responsible for the first American volunteer fire company in 1719 and, in 1750, introduced mutual fire insurance in America. The casualty development, which literally covers a multitude of risks, has, on the other hand, been largely a twentieth-century development, stimulated primarily by the advent of workman's compensation laws (1911) and of the automobile.

The interesting point, however, engineeringly speaking, is that efforts to reduce costs led to a careful selection of risks rather than attempting to make good risks pay for poor, and, thus, inevitably stimulated improvement through the reduction of risks by the adoption of better forms of construction and the elimination of hazards. "Slow-burning" mill construction and automatic sprinklers are examples of efforts to reduce losses. The engineering divisions, usually maintained by groups of mutual companies, play an important part in this movement and cover the inspection of properties, appraisal of risks, development of construction and other standards, and research as well as adjustments. Similarly, mutual casualty companies have played an important role in accident prevention and safety engineering. In short, insurance has been a vitally important factor, a beneficial force, in aiding and supporting better engineering. Mr. Bainbridge's book, while it contains little of technical engineering interest, thus reflects one of the many aspects of modern life which reinforces and strengthens the constant advance of engineering art and science, especially in the building, mechanical, and industrial areas.

[2] Dean emeritus and Renwick professor emeritus of Civil Engineering, Columbia University, New York, N. Y.

Books Received in Library

ADVANCED STRENGTH OF MATERIALS. By J. P. Den Hartog. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1952. Bound, 6¼ × 9¼ in., 379 pp., graphs, charts, tables, $8.50. Starting from the level attained by the first one-term course in engineering colleges this volume covers the following major subject headings: torsion; rotating disks; membrane stresses in shells; bending of flat plates; beams on elastic foundation; two-dimensional theory of elasticity; the energy method; buckling; miscellaneous topics such as Mohr's circle and certain specialized theorems.

CHARTING STATISTICS. By Mary Eleanor Spear. McGraw-Hill Book Company, Inc., New York, N. Y., 1952. Bound, 6¼ × 9¼ in., 253 pp., illus., charts, graphs, $4.50. A liberally illustrated textbook employing drafting-room methods of charting for practical graphic presentation of statistical data. Various interpretations of the same tables are used to illustrate the types of charts applicable to the given tables of facts. Among the varieties discussed are line, surface, column, bar, map, and flow charts.

DER EIGENBEDARF MITTLERER UND GROSSER KRAFTWERKE. By Alexander Roggendorf. Springer-Verlag, Berlin, Germany, 1952. Bound, 6¾ × 10 in., 222 pp., tables, diagrams, illus., charts. 31.50 Dm. This book deals with the internal electrical requirements of steam-electric power stations. It provides chapters on energy consumed within the plant itself, selection of drive and voltage, layout of the internal network, electrical equipment needed, plant supervision, control and signalling installations, and stand-by equipment. Schematic diagrams are extensively used to illustrate the text. There is a separate chapter dealing briefly with hydroelectric power plants.

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ENGINEER'S APPROACH TO THE ECONOMICS OF PRODUCTION. By John Reid Dick. Sir Isaac Pitman & Sons, Ltd., London, England, 1952. Bound, 5½ × 8¾ in., 248 pp., 21s. A discussion of the engineer's problems relating to capital investment and operating costs, this book deals with the behavior of all factors determining efficient production. The application of economic theories is used to further the ideal situation of optimum efficiency with minimum costs.

GRAPHISCHE BEHANDLUNG DER KOMPRESSIBLEN UND INKOMPRESSIBLEN STROMUNG DURCH TURBOMASCHINENSTUFEN. (Mitteilungen aus dem Institut für Thermische Turbomaschinen an der E.T.H., No. 2.) By Adel Gazarin. Verlag Leemann, Zurich, Switzerland, 1951. Paper, 6¾ × 9½ in., 89 pp., charts, 13.50 Swiss fr. A thesis dealing with three-dimensional compressible and incompressible flow between the long blades of turbomachines. A graphical method is developed which determines the radial variation of the velocity and density in the axial gap between the fixed and moving blades, which, in turn, determine the characteristics of the stage and the location of the meridional stream lines.

HANDBOOK OF APPLIED HYDRAULICS. Calvin Victor Davis, editor. McGraw-Hill Book Company, Inc., New York, N. Y., second edition, 1952. Bound, 6½ × 9¼ in., 1272 pp., illus., diagrams, charts, tables, graphs. $15. A general reference work on hydraulics, composed of brief, yet complete texts on its various branches with practical information on the planning and design of hydraulic works. Hydrology, river regulation, dams, spillways, canals, hydroelectric plants, hydraulic machinery, water supply, sewerage, irrigation, and so on, are discussed by twenty-two prominent engineers dealing with their specialized fields. In addition to the extensive revision in this edition, new sections have been added on water hammer, surge tanks, speed regulation, and navigation locks. Hundreds of graphs, diagrams, photographs, and detailed sketches supplement and illustrate the text.

HYDRAULICS AND ITS APPLICATIONS. By A. H. Gibson. Constable and Company Ltd., London, England, fifth edition, 1952. Bound, 6 × 9 in., 813 pp., charts, diagrams, illus., tables. 35s. The new edition of this well-known textbook has been revised to eliminate obsolete matter and by the addition of new material provide an up-to-date coverage of the subject. A new chapter dealing with the basic principles of the construction and operation of scale models has been included. The introductory section 1 covers hydrostatics and the physical properties of water; section 2, hydraulic theory for a variety of conditions; and section 3, the design of hydraulic machinery.

HYDRAULISCHE SCHMIEDEPRESSEN UND KRAFTWASSERANLAGEN. By Ernst Müller. Springer-Verlag, Berlin, Germany, second edition, 1952. Bound, $6^1/_2 \times 9^1/_4$ in., 208 pp., illus., diagrams, tables. 28.50 Dm. Covers design and construction of hydraulic forging presses including accessory tanks and piping and auxiliary equipment such as cranes, turntables, gripping devices, and so on. In addition to the detailed technical information there is also a general discussion of the comparative and economic aspects of different press types.

MANAGEMENT CONTROLS IN INDUSTRIAL RESEARCH ORGANIZATIONS. By Robert N. Anthony assisted by John S. Day. Harvard University, Graduate School of Business Administration, Boston, Mass., 1952. Bound, $5^3/_4 \times 8^1/_2$ in., 537 pp., tables. $6.75. Detailed results are presented of a broad first-hand study of the problems of administrative control of scientific research activities in American industry. Its four parts include a statement of the problem, the variable factors relating to it, current control practices, and case studies of control techniques in four specific laboratories of different sizes and kinds. Selected operating data for laboratories of different sizes and types of work are included in an appendix.

METALLURGICAL ENGINEERING. Volume 1, Engineering Principles. By Reinhardt Schuhmann, Jr. Addison-Wesley Press, Cambridge, Mass., 1952. Bound, $7^1/_2 \times 9^3/_4$ in., 390 pp., charts, diagrams, illus., tables. $7.50. The first volume of a two-volume work intended to meet the need for reorganization of instruction in extractive metallurgy in view of the changing outlook of the metallurgical profession. Its three main objectives are to organize the subject matter according to basic principles and unit processes rather than in accordance with metals treated; to integrate the underlying science of physical chemistry with metallurgical engineering; and to put greater emphasis on analysis and quantitative solution of engineering problems than on descriptions of current practice. Volume 1 deals with the engineering principles common to all the unit processes: stoichiometry, thermodynamics, fuels and combustion, fluid flow, heat transfer, pyrometallurgical systems, and refractories. Volume 2 will take up the individual unit processes themselves.

STANDARDS OF HYDRAULIC INSTITUTE. Published by Hydraulic Institute, New York, N. Y., ninth edition, 1951. Paper, $9 \times 11^1/_4$ in., various paging, tables, charts, diagrams. $3. Each of the standards in this compilation "defines a product, material, process, or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, quality, rating, testing, and service for which designed." Intended to be of mutual advantage to manufacturers, users, and engineers the standards provide necessary technical details and extensive graphical data in each section. A separate section on pipe friction is included as well as the three major classifications of centrifugal, rotary, and reciprocating pumps.

STEELS IN MODERN INDUSTRY. Edited by W. E. Benbow. Iliffe & Sons, Ltd., London (available in U. S. from British Book Centre, New York, N. Y., 1951. Bound, $5^3/_4 \times 8^3/_4$ in., 562 pp., diagrams, tables, illus., charts, $9. Part 1 of this compact reference work is a general metallurgical introduction covering the principal types in steel in relation to composition and heat treatment. Part 2 contains a series of general articles on the properties and characteristics of steels under the major operating conditions of stress temperature, and environment encountered in service. Part 3 deals with selected and specific user aspects in the fields of structural, mechanical, and electrical engineering. In Part 4 consideration is given to some of the more important forms of surface treatment. A selected list of references is appended to each article.

TECHNOLOGY OF COATED AND PROCESSED PAPERS. Edited by Robert H. Mosher. Remsen Press Division, Chemical Publishing Company, Inc., New York, N. Y., 1952. Bound, $5^3/_4 \times 8^3/_4$ in., 733 pp., illus., charts, diagrams, tables. $15. Intended for the technical worker, chemist, and engineer, this book presents a detailed picture of the modern raw materials, manufacturing processes and equipment, and formulations used in the various branches of the specialty-paper industry, discussing also the finished products and their evaluation. Written by specialists in the several fields the book emphasizes the contributions of new synthetic coatings, adhesives, and pigments. A previously published companion volume dealt with properties and uses of specialty papers.

ASME BOILER CODE

Cases Annulled

SINCE publication of the list appearing in MECHANICAL ENGINEERING, May, 1952, the following Case Interpretations have been annulled by the Boiler Code Committee. They became obsolete by publication of the items indicated under Reasons for Annullment. Referenced foot-notes give the date of the meeting at which each case was annulled:

Case No.	*Reasons for Annullment*
986[1]	Appendix A-130 to A-132 incl.
1063[3]	Par. H-83(1)
1082[2]	Par. P-115(a)(7)(8)
1088[1]	Spec. SA-217
1123[3]	Par. H-83(1)
1128[1]	Case No. 1143
1131[2]	Par. P-7
1148[3]	1952 Addenda to Low-Pressure Heating Boiler Code
1152[3]	Revised Section IX, 1952 Edition

[1] November 2, 1951.
[2] March 7, 1952.
[3] October 31, 1952.

Announcement

The American Society of Mechanical Engineers announces the publication of the 1952 Edition of Section VIII, Unfired Pressure Vessels, of the ASME Boiler and Pressure Vessel Code. The new edition contains the parts that were omitted from the interim Edition of 1950 because of the delays resulting from World War II, as well as parts that have heretofore been covered only by Code Cases.

The problem of handling the additional text imposed by these added parts was solved by increasing the page size to $8^1/_2$ by 11 inches. This change provides a book of usable proportions, and is in line with the trend set by several recent codes and standards. The larger page size permits the use of an adequate scale for figures and charts and simplifies the printing of tables of stress values.

The 1950 Edition arranged the requirements in several parts consisting of general rules, and rules applicable to each of several methods of fabrication. The rules in each part were further arranged under subheadings, such as Materials, Design, Fabrication, and Inspection and Tests. This method has been amplified in the present edition.

The 1952 Edition is divided into three subsections. Subsection A consists of Part UG containing the requirements common to all pressure vessels regardless of materials or fabrication method. Subsection B consists of Parts UW, UR, UB, and UF dealing respectively with welded, riveted, brazed, and integrally forged vessels. Subsection C consists of Parts UCS, UNF, UHA, UCI, and UCL dealing respectively with carbon and low-alloy steels, non-ferrous metals, high-alloy steels, cast iron, and clad and lined vessels. Part UCS contains the specific rules for carbon steel that were in the 1950 Edition. The rules in Parts UNF, UHA, UCI, and UCL are primarily from the 1949 Edition or from Code Cases.

The revisions given in the 1950 and 1951 Addendas have been incorporated in the new edition together with later revisions approved by the Boiler Code Committee. A few rules in the 1949 Edition have been readopted where experience has shown the 1950 change to have been less desirable.

A new method for the design of shells and heads under external pressure is included. The method may be used for any material for which compression stress-strain diagrams are available at the required temperature. New charts have been constructed for steel and for many of the non-ferrous metals, and illustrative examples are given to explain their use.

The basis on which stress-values in non ferrous metals have been established is given in Appendix Q. This compares with Appendix P for steel which first appeared in the 1950 Edition.

ASME NEWS

With Notes on the Engineering Profession

The 1953 ASME Spring Meeting Scheduled at Columbus, Ohio April 28-30

Headquarters: Deshler-Wallick Hotel

THE Columbus Section of The American Society of Mechanical Engineers is making elaborate preparations for the ASME Spring Meeting to be held at the Deshler-Wallick Hotel in Columbus, Ohio, April 28-30, 1953. This will be the first time that mechanical engineers of Columbus and central Ohio have played host to a national meeting of the Society. It is hoped that the several thousand engineers from all over the United States, who are expected to attend, will help to make this meeting one of the high lights in this Ohio sesquicentennial year.

Early plans include presentation of technical papers in the fields of machine design, hydraulics, gas turbines, fuels, power, production engineering, and management.

Columbus—Capital of Ohio

Columbus, as a capital city, is unique in that it did not become Ohio's capital—the capital became Columbus. When the then youthful State of Ohio, more than 125 years ago, decided to seek a centrally located site for its capital, the decision incited a number of pioneer settlements to contest spiritedly for the prize. However, the legislators, on Feb. 14, 1812, accepted an offer made by a syndicate of landowners to build the capital on the "high bank east of the Scioto River directly opposite the town of Franklinton." On February 22, in honor of the discoverer of America, the Legislature adopted the name "Columbus" for the embryo capital.

In stride with the industrial development, from its earliest beginning with a few small sawmills, tanyards, flour mills, distilleries, and breweries, the population grew.

Entire River Front Rebuilt

The community's most destructive flood came in 1913 and in its aftermath the city transformed the entire river front, widening the Scioto's channel, building levees, retaining walls, and modern bridges, and laying the foundation for what now is the city's chief pride—the Civic Center. It was also in this period that Columbus modernized the form of its city government.

Port Columbus, one of the country's finest aviation centers, was opened in 1929. With the new airport came the inauguration of transcontinental air service and Columbus was established as an important terminal. The principal units of the Civic Center were built or started in this decade and Ohio Stadium, one of the largest in the country, was completed at the Ohio State University.

Having long since outgrown the strictly capital-city classification, Columbus has emerged as a many-sided community, well-balanced industrially, commercially, and in its cultural phases.

Committees

The following committee is in charge of local arrangements for the meeting: Ralph A. Sherman, *general chairman;* Mrs. Bertrand Landry, *ladies;* Elmer R. Kaiser, *finance;* Marion L. Smith, *publicity;* Richard B. Engdahl, *technical events;* Carl J. Lyons, *information and registration;* Ernest B. Lund, *hotel;* Harry C. Ballman, *entertainment and registration;* Dan H. Vogel, *inspection trips;* and Walter L. Hartman, *printing and signs.*

Further details of the 1953 ASME Spring Meeting will be announced in the February issue of this magazine.

DOWNTOWN COLUMBUS, OHIO, AS SEEN FROM THE AIR

(The capital city of the Buckeye State will be the scene of the 1953 ASME Spring Meeting. Columbus, celebrating the Ohio sesquicentennial this year as an industrial and educational center, is proud of her 776 manufacturing establishments, three universities, four colleges, and eight research organizations. The ASME meeting will be held in the Deshler-Wallick Hotel, April 28-30.)

ASME Membership as of Nov. 28, 1952

Honorary Members	54
Fellows	380
Members	13,546
Associates	351
Juniors (33 and over)	3,182
Juniors (30-32)	1,865
Juniors (to the age of 29)	18,738
Total	38,119

The President's Page

Let Us Hold Our Torch High

HIGH among the lofty purposes which impelled our founders to establish The American Society of Mechanical Engineers, as more lately recited in the constitution and by-laws, was to advance the standards of engineering. In its 71 years as the rallying point and recognized mouthpiece of mechanical engineers, the ASME has never had occasion to offer apologies for its record in promoting this objective. May it never have to!

Yet, there is perhaps no word in the English language which is more abused and misused than the term "engineer." Unhappily, we cannot copyright it in some such manner as the real-estate men coined and copyrighted the term "realtor" to prevent its prostitution by the incompetent and the unworthy, for, alas, the abuse is of too-long standing; but we can and should insist that the emphasis on membership in our Society, however much we want more members, should be on quality rather than quantity. In brief, as the years roll by, I should much prefer to see the requirements for full membership made more, rather than less rigid. Quality and worth will always attract a following.

Especially do I urge that there be no compromise with the standards of professional competence established for admission to the grade of Member, which should always be a special badge of technical competence. In advancing this suggestion, I draw no invidious comparisons between the grade of Member and the grade of Associate member. The contribution of the latter to our Society has been a very real and a very great one which should be encouraged. Indeed, the inclusion on our rolls of men of ability, who have a record of leadership in the fields related to mechanical engineering, lends elements of breadth and balance to our Society which are in every sense desirable. However, I hold that the term "Member of The American Society of Mechanical Engineers" should be something like a college degree, which can be won only by meeting satisfactorily certain rigid and formal stipulations. The possession of such a degree constitutes notice to the world that the holder has met such stipulations. His other qualifications, however eminent, do not and can not entitle him to its use. Membership, in the grade of Member, in The American Society of Mechanical Engineers similarly should constitute notice to the world that the holder of such membership is, in fact, a competent engineer. If we guard our portals jealously, we shall enhance not only the standing of our Society, but of its Associate and Junior grades of membership as well.

FREDERICK S. BLACKALL, JR., *President*
The American Society of Mechanical Engineers

W. L. Batt and F. O. Hoagland Honored at 34th ASA Annual Meeting in New York

CHAOTIC practices that exist in the drawing and drafting rooms of Great Britain, Canada, and the United States are dangerously impeding the rearmament effort of the North Atlantic Treaty Organization. This statement was made by William Loren Batt, past-president and Hon. Mem. ASME, retiring U. S. Minister for economic affairs to the United Kingdom, and featured speaker at the annual meeting award luncheon of the American Standards Association, held at the Waldorf-Astoria Hotel, New York, N. Y., Nov. 25, 1952.

The situation could be remedied, Mr. Batt added, if industrial leaders of the three countries would order simple steps to be taken to standardize practices in making engineering drawings and blueprints. Costly production delays are resulting from the need to redraw American, British, and Canadian blueprints to fit the shop practices of the individual countries. In urging the standardization of this work, he said, it probably would be the most important single step the three countries could take to make better use of their combined resources.

"We need to harmonize our national standards with those of our allies and friends," Mr. Batt stated. "We are procuring arms in Europe to American design. We are making arms in America to European design. Under such circumstances, it is sheer folly to allow the small dangerous differences to continue that confuse and delay the industrial production of the free nations."

"This is the third time" he said, "we have come to the aid of Europe, and each time we have faced the same headaches, the same delay, and waste arising from lack of adequate national and international standards."

Talking about the European situation, he stated that the Soviet Union is pushing all its seven satellites on the Continent to standardize their weapons and industrial production with hers. "She is straining the manpower and resources of Eastern Europe," he said, "for an integrated, Russian-controlled economy." He said that new engineering standards received from Czechoslovakia are now carrying the same number as the Russian standard on the same subject, have titles in both Russian and Czech, and carry notations on their differences.

In reporting on his two years of work in England Mr. Batt made the following points: U. S. Military procurement practices are far better than they were in World War II; U. S. orders totaling $729 million in 13 European nations are producing arms and military equipment cheaply; only through increased production accompanied by expanding foreign trade can Western Europe rearm, maintain its standard of living, and eventually free itself from dependence on U. S. aid; standardization of weapons, equipment, training, and procedures is essential if the armies of the NATO nations are to operate efficiently, and Europe is eager for U. S. co-operation in technical matters.

Mr. Batt was awarded the ASA Howard Coonley medal, which is given annually to a business executive in recognition of services in standards work. He was introduced by Robert M. Gates, past-president and Fellow ASME, who was his classmate in the 1907 Class of Purdue University.

Frank O. Hoagland, Mem. ASME, was awarded the association's Standards Medal, which is given annually in recognition of service in the development and practical application of industrial standards. He was introduced by Col. W. T. Chevalier. Mr. Hoagland made a delightful acceptance talk and recalled how he often had to "dig deep" to tell about his pet subject—standardization. The talks were quite often given before some "very unlikely" audiences.

Roger E. Gay, who was re-elected president of ASA, presided over the meeting luncheon.

F. O. HOAGLAND, *right*, RECEIVES THE ASA STANDARDS MEDAL FROM R. E. GAY

W. L. BATT RECEIVES THE HOWARD COONLEY MEDAL

(*Left to right:* R. M. Gates, who made the introduction, Mr. Batt, and R. E. Gay, president ASA.)

ASME Calendar of Coming Events

April 28-30
ASME Spring Meeting, Deshler-Wallick Hotel, Columbus, Ohio
(Final date for submitting papers was Dec. 1, 1952)

May 24-28
ASME Oil and Gas Power Division Conference, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers was Jan. 1, 1953)

June 28-July 2
ASME Semi-Annual Meeting, Hotel Statler, Los Angeles, Calif.
(Final date for submitting papers—Feb. 1, 1953)

Sept. 21-25
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Chicago, Ill.
(Final date for submitting papers—May 1, 1953)

Sept. 28-30
ASME Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Texas
(Final date for submitting papers—May 1, 1953)

Oct. 5-7
ASME Fall Meeting, Hotel Sheraton, Rochester N. Y.
(Final date for submitting papers—July 1, 1953)

Nov. 29-Dec. 4
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1953)
(For Meetings of Other Societies, see page 95)

UET Annual Report for 1951–1952

The President's Report for the Forty-Eighth Year

THE Annual Report of the United Engineering Trustees, Inc., for 1951–1952 was issued by R. F. Gagg, president UET. The following excerpts are from Mr. Gagg's report:

At the turn of the century Andrew Carnegie was engaged in generously disbursing his wealth by providing library buildings for communities proving their interest and need. During that time, the young American Institute of Electrical Engineers was offered a valuable collection of engineering books—with the provision that the Institute provide suitable fireproof housing for the collection. The Institute turned to Mr. Carnegie for assistance. He showed no great interest in the need for a technical library at that time, but later became enthusiastic about the idea of close co-operation among the four basic branches of the engineering profession. The event which sparked his interest in this concept was the inauguration of the John Fritz Medal to honor the great steelmaker and industrialist by the joint action of the civil, mining, mechanical, and electrical engineering societies in 1902. In this action he saw the possibilities and great benefits which could result from the close co-operation of engineering societies. In 1904, when the combined membership of these four societies was 12,341 (now more than ten times that number), Mr. Carnegie made a gift of a million and a half dollars for the erection of a suitable home for the societies, which was also to include a great engineering library. Thus our Engineering Societies Building—conceived as a complete home for the engineering profession—grew out of the need for a library building.

The United Engineering Trustees, Inc. was established by the Founder Societies to fill the need for a co-operative organization to carry on by joint action the functions which they individually cannot do effectually for "the advancement of the engineering arts and sciences in all their branches, and to maintain a free public engineering library," as provided in our Charter. The members of the Board of Trustees are appointed by the four societies as their official representatives in the co-operative organization. The Charter, established by a special act of the New York State Legislature, provides that the Trustees are the legal representatives of and can act for the Founder Societies in all matters of joint interest. Routine duties of the Trustees include the operation and control of the Engineering Societies Building, the Engineering Societies Library, the Engineering Foundation, and the financial operations involved in the care of trusteed funds, both for safety of the principal and to obtain income for the conduct of our joint interests on behalf of the member societies.

The Engineering Societies Building

Built in the classic type of architecture, and dedicated in 1907, the Engineering Societies Building has served very usefully through 45 years of wear and tear. It has served well as the official home of the engineering profession during a period which has seen a tenfold growth in the membership of the Founder Societies, and the ramifications of engineering technical activities have added staff loads to the point where the building is no longer adequate for its original purpose and is far too small to house all of the activities of the Founder Societies or the several other engineering professional societies which would like to have their offices in an adequate home, together with the Founder Societies. The Mechanical Engineers and the Electrical Engineers, in addition to their offices in the Engineering Societies Building, have some of their activities scattered in considerable outside space. Over the years there has been much discussion concerning a new building, but no action has resulted. The situation now has become critical, and the societies are urging the trustees to action. Our depreciation reserve, plus the market value of the Engineering Societies Building, give us a goodly sum to apply toward acquisition of a new building, but several million dollars must be provided from other sources. Ways and means are being sought to establish a new engineering center to include the entire profession in accord with the original concept endowed by Andrew Carnegie. A plan for co-operative action by the Founder Societies and others is being developed to the end that a new home for the profession may be provided which is adequate for modern requirements.

All available office space in the building is occupied and paying its share of operating costs.

The city assessment register values our property at $950,000 of which $430,000 is for land which leaves $520,000 for the building. The property remains tax-exempt. Fire insurance (with extended coverage) on the building is carried at $1,904,000 above foundations. This is believed to be adequate. Our insurance counsel made a complete inspection and has assured us of the generally good condition of the building from an insurance viewpoint.

Financial

The Finance Committee has been alert to changing market conditions which concern our portfolio, watching for possible weakness, and endeavoring to strengthen our holdings.

One of the principal studies, which the committee undertook in co-operation with our investment advisers, was the selection of items in our portfolio desirable for segregation in establishing a separate depreciation reserve. This segregation is advantageous in the event of the acquisition of a new building. It would provide ready cash for this purpose without hasty selection of securities to be sold, which might later prove to favor either part of the present fund. A fully equitable selection has been accomplished under unhurried conditions with the advice and guidance of competent investment counsel.

After paying for elevator repairs to remove the city "violations," the depreciation reserve amounts to $854,367.63 at the close of the year. This is far below the original Carnegie gift and below depreciation value

D. K. HART RECEIVES NAVY AWARD

The Honorable Herbert R. Askins, *second from left*, Assistant Secretary of the Navy, presents the Navy's highest civilian award to David K. Hart, Jun. ASME, associate head of the propulsion division of Underwater Ordnance, during ceremonies held Nov. 6, 1952, in the office of the Station Commander, U. S. Naval Ordnance Test Station, China Lake, in California's Mojave Desert. Present for the ceremony were, *left to right*, Lieut. Comdr. H. J. Kossler, Aide to Mr. Askins; Mr. Askins, Mr. Hart, W. J. Saylor, associate director for Pasadena; Captain Paul D. Stroop, Station Commander; Captain Levering Smith, associate technical director; and Frederick W. Brown, technical director

for a building 45 years old. During the year $20,000 was appropriated to the reserve and $45,077.21 from investments.

Principal Funds

The monies controlled by the Board of Trustees include our own reserves (such as the building depreciation reserve and a small reserve against operating contingencies); gifts (the principal of which is to remain intact and the income therefrom only, to be applied to the use of the Engineering Foundation); funds of the Engineering Societies Library, the Medal Boards, and the like; contributions from industry for various projects, such as those sponsored by the Engineering Foundation, which are subject to disbursement order of the directors of those projects. Major reserves and funds total $2,133,403.40, book value, with a market value of approximately $2,509,068.12, or 118 per cent of book value. The year preceding showed market value as 117 per cent of cost value. All accounts are subject to semiannual audit by Haskins & Sells and are under the constant supervision of our general manager.

Fiduciary functions are conducted as Treasurer for the Engineers' Council for Professional Development, and as custodian of funds for the John Fritz Medal Board of Award and the Daniel Guggenheim Medal Board of Award; for contributions for the support of the Welding Research Council, Alloys of Iron Research Committee, Column Research Council, Research Council on Riveted and Bolted Structural Joints, Council on Research in Reinforced Concrete, Research Council on the Causes and Methods of Prevention of Corrosion of Water Pipes, and others sponsored by the Engineering Foundation.

ASME Members on the UET Board of Trustees are Warner Seely, J. L. Kopf, and R. F. Gagg.

Engineering Societies Library Annual Report

Ralph H. Phelps, director, Engineering Societies Library, reported that the Library served more engineers by mail and telephone than in any previous year. For the first time more nonvisitors than visitors were served. Income from searching, translating, and photocopying increased. The Library's expenses have been kept within its income.

Statistics of Library Use

	1950–1951	1951–1952
Visitors served ..... total	18,104	17,585
Nonvisitors served .. total	16,783	21,255
Total	34,887	38,840
Photostat orders	4,251	4,381
Photostat prints	51,219	52,003
Microfilm orders	217	176
Bibliography orders	635	206
Searches and paid services	114	153
Translations	108	184
Words translated	173,656	310,838
Borrowers	1,691	1,943
Books lent	2,425	2,803
Telephone inquiries	6,655	11,092
Letters written (exclusive of book orders)	3,112	3,120

Promotion of the Library

Much attention has been given to making the Library's services and facilities better known. Promotion has been discussed at all meetings of the Library Board.

Colorful Kodachrome transparencies exhibited in an automatic slide projector at the Centennial of Engineering in Chicago, Ill., brought the services of the Library to the attention of thousands of members of the Founder Societies as well as to other engineers.

Another display, produced by The American Society of Mechanical Engineers with the co-operation of the Library, was exhibited at a UNESCO meeting at Hunter College, and at the American Institute of Mining and Metallurgical Engineers' annual meeting in New York, N. Y. The Director of the Library attended these and other conventions and meetings, and at several gave talks about the Library's services.

Other promotional activities and exhibits are being planned by the Library Board to increase the use of the Library. Income from photoprint, microfilm, search, and translation services has tripled in the past 20 years, while the Founder Societies' support of the Library has increased about 50 per cent, entirely as a result of increased society membership, for the contribution per member has remained the same.

In recognition of the value of the Library to their members and their staffs, certain technical societies, other than the Founder Societies, contributed $1900 to the Library. Nuclear Development Associates gave $175 as an expression of appreciation for the use and services of the Library. Such gifts are helpful and are much appreciated. Others should be encouraged to give such concrete expression of their appreciation of the value of the Library.

The Library Staff

This year the Staff of the Order Department has changed completely. Miss Reba Gore, head of the department, and Miss Marian Stansfield, her assistant, both became ill. They were retired at the end of the year as neither is able to return to work. They have been with the Library 32 and 33 years, respectively. Charles S. Rehn, who has been an assistant in the Reference Department for five years, is now in charge of the Order Department.

Literature Searching and Translating

The use of these services has increased so much this year that the search department has not had time to prepare any new ESL Bibliographies. The sale of the six bibliographies still in print continues, although at a slower rate. Two bibliographies are out of print.

In addition to the technical translation work done for engineers, the Library Staff translates letters for the Founder Societies at a very low charge. The 478 letters translated in the past year were divided as follows: ASCE, 40 letters; AIME, 193 letters; ASME, 200 letters; and EJC, 45 letters.

Protection of the Collection

Because mutilation of some material in the Library had become serious, new shelving was installed to provide an enclosed alcove adjacent to the Reference Desk. Some material has been moved into that alcove so that its use can be better supervised. New and additional signs warning against mutilation were placed in the Reading Room.

The amount of insurance on Library books, catalog, and equipment, which had not been changed for many years, was increased to cover the current value as estimated by the Director and Mr. Goodrich, head of the reference department.

Miscellaneous Activities

The Library Staff prepared reviews of 484 books valued at $2770. These reviews are supplied to the four Founder Societies, The Engineering Institute of Canada, and the Engineering Index. In addition to the value of books received for review, the Library spent $1947 for books that were not reviewed.

A new Engineering Societies Monograph entitled "The Buckling Strength of Metal Structures," by Friedrich Bleich, was published. The Engineering Societies Monograph series is controlled by a separate committee of the Founder Societies rather than by the Library Board. The series is of interest to the Library in two respects—the royalties from the series are paid to the Library, and the Director serves as chairman of the Engineering Societies Monographs Committee. Royalties received by the Library since the series started in 1931 amount to $9999.29.

The snow, ice, and permafrost bibliography being received from the Library of Congress in return for help given them, has grown from 600 to 3000 references during the year.

Periodicals

Periodicals form a very important part of the Library's collection as they report new developments promptly and because many subjects are so specialized that they are treated only in periodicals—not in books.

Periodicals received	1950–1951	1951–1952
Subscription	374	376
Exchange	242	245
Gift	776	771
	1392	1392

Acquisitions

Items received: Innumerable. Many obviously of no value.

Items kept:

Volumes	1,785
Maps	747
Searches	82
Pamphlets	2,504*
	5,118

Items withdrawn from the Library:

Volumes	1,038
Maps	1
	1,039

Net accessions as of September 30, 1952:

Volumes	171,181
Maps	13,534
Searches	5,316
	190,031

* These were inserted in volumes already cataloged so do not add to the total number of volumes.

Over one third of the items kept were gifts. They came from many individuals, societies, companies libraries, and schools. These gifts are helpful as it is difficult or impossible to get some of the material through the usual commercial channels.

The Engineering Foundation

In his annual report, Frank T. Sisco, technical director of the Engineering Foundation, UET, stated:

At the annual meeting of the Engineering Foundation Board, on Oct. 18, 1951, grants totaling $36,000 were approved for the support of sixteen projects during the fiscal year 1951–1952. During the year all of these projects were active, and all made substantial progress, which is summarized below. None of the grants was unexpanded at the end of the fiscal year.

The distribution of Foundation grants among the Founder Societies for the fiscal year 1951–1952 was as follows:

ASCE, six projects	$ 7,500.00
AIME, four projects	11,500.00
ASME, four projects	6,000.00
Joint activities, two projects	11,000.00
Total	$36,000.00

Summary of 1951–1952 ASME Projects

Of the four research projects sponsored by ASME for the fiscal year 1951–1952, one is new; the others have received sporadic financial support from the Foundation for 20 to 30 years. The experimental work outlined by the ASME Committee on Lubrication about four years ago was completed early in 1951, and the small Foundation grant of $1000 for 1951–1952 to this project (Lubrication, 23) was made for the specific purpose of completing the final report. This has been done, and plans are under way for final publication of the large volume of tabular and graphical data obtained during the four-year experimental program and from the extensive survey of the literature that was also made.

The Foundation made a token grant of $1000 to project 45, "Effect of Temperature on the Properties of Metals," to aid in work along three lines: (1) determining the effect of certain elements on graphitization of steel; (2) making a survey of elevated-temperature properties of copper-base alloys; and (3) making notched-bar and fatigue tests of N-155 alloys. All of these projects are under way. The Joint Committee of ASME and ASTM, in charge of this work, is supervising several other research projects carried on in industrial laboratories, which do not involve the use of Committee funds.

The Joint Committee raises its research funds at intervals. About a year ago the Committee started a campaign to raise $85,000; as of Sept. 30, 1952, it had $46,075 on hand.

The ASME-sponsored work on High-Temperature Steam Generation (project 50) has been going on since 1932, and a large volume of valuable data, both from laboratory tests and from power-plant studies, has been accumulated. One phase of the work, a study of the behavior of a group of alloy steels in contact with the products of combustion at 1350 F, was finished during the 1951–1952 fiscal year. Another phase, which is still going on, is the determination of the performance characteristics of selected ferritic and austenitic tubular materials subjected to steam at 2000-psi pressure, and at temperatures of 1100, 1200, and 1350 F for periods ranging from six to thirty-six months. The annual budget of this project for research is in the neighborhood of $30,000, and contributions in services and materials are high.

The fourth ASME-sponsored project, Properties of Gases and Gas Mixtures (project 91), was started about a year ago after several years of planning. The program includes determination of the heat conductivity and viscosity of some ten gases and gas mixtures at temperatures ranging from about −300 to +750 F. All of the experimental work for this project has been done at Massachusetts Institute of Technology.

National Research Council Activities

The Technical Director attended the annual meeting in Washington of the NRC Division of Engineering and Industrial Research, as official representative of the Foundation, on May 22, 1952. He continued to act as adviser and informally as editor for the monthly "Engineering Newsletter" published by the NRC Committee on International Scientific Publication for foreign distribution by the U. S. Department of State. Two conferences were held with the executive secretary of this NRC committee while the technical director was in Boston on other Foundation business.

Engineers Joint Council Activities

In October, 1951, the technical director was asked to serve as secretary for a "Commission on Technical Assistance," which had been set up by the Committee on International Relations of the Engineers Joint Council. The objective of the Commission is to lend technical aid to the U. S. Department of State, the United Nations, and UNESCO. Such aid was requested several times during the past six months, and four meetings of the Commission were held.

Conference on the Administration of Research

The conferences on the administration of research were started six years ago to bring leading research directors together for the purpose of discussing once a year general problems in planning and administering scientific research. Attendance is restricted to 80 from industry, 80 from universities and research institutes, and 40 from government. The technical director of the Foundation was included in the invitation list in 1951 and 1952. On September 8–10, he attended, as representative of the Foundation and the engineering profession, the sixth conference at Georgia Institute of Technology, Atlanta, Ga.

The topics discussed at this conference included methods of communicating the results of research, program planning, and scientific manpower. Many of the topics considered at these annual conferences are important to the future operation of the Foundation, and for this reason the Technical Director considers that his attendance at these meetings is well worth while. In addition, the Technical Director feels that, in the past, engineering research has not been adequately considered, and that his regular attendance may aid in establishing a better balance between engineering research and research in some of the other sciences.

E. L. Robinson and H. Weisberg served as ASME representatives on the Board of the Engineering Foundation.

Nominations Sought for ASME 1953 Awards

ALL members or agencies of the Society such as Committees, Sections, and Professional Divisions, are encouraged to submit nominations for the various awards not later than March 1 of each year. Each nomination should be supported by the following: (1) Full statement of the training, experience, and notable contribution of the nominee; (2) statement of the basic reasons for submitting the nomination and for believing the nominee eligible for the honor; (3) a citation of about 50 words stating clearly the specific reason the nominee is recommended; (4) other information and reference which will assist the Board on Honors in considering the nominee.

It is absolutely essential that such nomination carry the present title and company connection of the candidate, or if he is retired, his present residence address.

Those wishing to make a nomination should first obtain a copy of a Manual on ASME Honors and Awards. This may be had by writing to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

Awards for 1953

Honorary Membership: Five may be awarded each year. An essential qualification is "eminence in the engineering field." These awards are not limited to Society members. Eminent engineers from other countries are eligible for consideration. A nominee must be endorsed by twenty-five members of the Society.

ASME Medal: This award is made for distinguished service in engineering and science, and may be conferred in recognition of general service in science having possible application in engineering.

Holley Medal: The award is made for some "great or unique act of genius of an engineering nature that has accomplished a great and timely public benefit."

Worcester Reed Warner Medal: This award is made to honor the author of an outstanding contribution to permanent engineering literature. Permanent literature may be a book or group of books, or a single paper or group of papers, not less than five years old, which has (or have) been recognized as noteworthy and permanent contribution to engineering literature.

Spirit of St. Louis Medal: This award is made at three-year intervals for meritorious service in the advancement of aeronautics. It may be given either to a member of the Society or to a member or nonmember of the engineering profession.

To ASME Members:

Nominations Open for 1954 Officers

This Is Your Opportunity to HELP

THE 1953 National Nominating Committee of the Society is ready to receive proposals for candidates for the offices to be filled for 1954. It is the obligation, privilege, and responsibility of every member of the Society to assist the Committee in obtaining the best men available. You can do your part by acting as a sponsor for those members who have the acknowledged qualities of outstanding ability and leadership in their profession.

Offices to Be Filled

President	To serve 1 year
Vice-President	To serve 2 years, Region I
Vice-President	To serve 2 years, Region III
Vice-President	To serve 2 years, Region V
Vice-President	To serve 2 years, Region VII
Directors at Large (2)	To serve 4 years

Act Now!

Proposals will be welcomed by the Committee.

1 Proposed candidates' names and records should be submitted on the official proposal form which may be obtained from the Secretary of the National Nominating Committee or any of its members listed below.

2 Completed forms should be sent to the Secretary of the National Nominating Committee, Karl P. Hanson, Mechanical-Engineering Department, North Carolina State College, Raleigh, N. C. Proposals for Vice-Presidents are requested in advance of the respective Regional Administrative Committee meetings and proposals for all offices should be submitted before April 1, 1953.

3 The proposer, not the proposed candidate, should fill out the form.

4 Before submitting the name of a proposed candidate, the proposer shall ascertain that the proposed candidate will accept the nomination if tendered.

Members are reminded that in accordance with the Society's Constitution, candidates for office of President, Vice-President, and Director at Large shall be of the grade of Fellow or Member. Members wishing to speak in support of any proposed nominee have the privilege of appearing before the National Nominating Committee at open hearings to be held during the Semi-Annual Meeting in Los Angeles, Calif., Hotel Statler, June 28 July 2, 1953.

1953 National Nominating Committee

Region I: Harry E. Harris, Sr., consulting engineer, 229 Thorme St., Bridgeport 6, Conn.; A. C. Crownfield, Jr., *1st Alternate*, 138 Clearfield Rd., Wethersfield 9, Conn.; L. E. Seeley, *2nd Alternate*, College of Technology, University of New Hampshire, Durham, N. H.

Region II: William H. Byrne, Byrne Associates, Inc., 50 Broadway, New York 4, N. Y.; W. A. Johnston, *1st Alternate*, Sanderson & Porter, 52 William St., New York 5, N. Y.; F. L. Bradley, *2nd Alternate*, Forstmann Woolen Co., 2 Barbour Ave., Passiac, N. J.

Region III: George M. Muschamp, c/o B. I. Division, Minneapolis-Honeywell Regulator Co., Wayne and Roberts Aves., Philadelphia 44, Pa.; J. William Putt, *1st Alternate*, Hahn Motors, Inc., Hamburg, Pa.; W. N. Richards, *2nd Alternate*, International Correspondence Schools, 1001 Wyoming Ave., Scranton 9, Pa.

Region IV: Karl P. Hanson, Mechanical-Engineering Department, North Carolina State College, Raleigh, N. C.; Roy C. Robertson, *1st Alternate*, Mechanical-Engineering Department, University of Tennessee, Knoxville 16, Tenn.; E. M. Williams, *2nd Alternate*, Clinchfield Fuel Company, Box 410, Spartanburg, S. C.

Region V: W. A. Carter, The Detroit Edison Company, 2000 Second Ave., Detroit 26, Mich.; E. W. Allardt, *1st Alternate*, Welded Tube Division, The Babcock & Wilcox Company, Alliance, Ohio; Ralph A. Sherman, *2nd Alternate*, Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio.

Region VI: R. S. Stover, R. S. Stover Company, 212 Kresge Building, Marshalltown, Iowa; Donald B. Naulin, *1st Alternate*, The Falk Corp., 122 S. Michigan Ave., Chicago 3, Ill.; M. H. Linn, *2nd Alternate*, Deere & Company, Moline, Ill.

Region VII: A. R. Weigel, Consolidated Western Steel Corp., Box 2015, 5700 S. Eastern Ave., Los Angeles 54, Calif.; S. T. Johnson, *1st Alternate*, American Smelting & Refining Company, Garfield, Utah; B. G. Dick, *2nd Alternate*, Department of Interior, Bonneville Power Administration, 1300 N. E. Union Ave., Portland, Ore.

Region VIII: R. P. Lockett, Jr., c/o A. M. Lockett & Co., 308 Whitney Building, New Orleans, La.; Carl A. Stevens, *1st Alternate*, Oklahoma Institute of Technology, Oklahoma A&M College, Stillwater, Okla.; R. B. Stewart, *2nd Alternate*, Mechanical-Engineering Department, University of Colorado, Boulder, Colo.

Gala Activities Fill Crowded Week at ASME Woman's Auxiliary 29th Meeting, at New York, N. Y.

Mrs. Charles M. Hickox Elected President for 1953

THE twenty-ninth Anniversary Meeting of the Woman's Auxiliary to the ASME was held concurrently with the 1952 ASME Annual Meeting in New York, N. Y., November 30 to December 5, with headquarters at the Statler Hotel. A record number of 560 registered at Auxiliary Headquarters and each event in the week-long program was marked by overflow attendance.

During the past year the Woman's Auxiliary has achieved a new high in membership, approximately 1200. There are 16 sections, two of which were recently organized, Buffalo Section, Buffalo, N. Y., and Iowa-Illinois Section, Rock Island, Ill.

Annual Meeting Officers

As is usual when the Annual Meeting is held in New York, the Metropolitan Section acted as hostess to the visiting ladies. The officers for the Annual Meeting were: honorary chairman, Mrs. C. M. Hickox, president-elect; general chairman, Mrs. U. A. Rothermel, chairman, Metropolitan Section; general vice-chairman, Mrs. W. E. Case, vice-chairman, Metropolitan Section. Mrs. Crosby Field and Mrs. H. R. Kessler were chairman of Registration.

Sunday Reception

A new feature of the Annual Meeting was a reception at the Engineering Woman's Club on Sunday afternoon. The rooms were attractively decorated with large gilt straw hats filled with yellow chrysanthemums and daisies dyed a deep blue to form the ASME colors. Huge punch bowls and attractive trays of hors d'oeuvres in the various clubrooms made refreshments readily available to the nearly 200 ASME men and women who attended this affair. Mrs. Randall Purdy was chairman of the function, assisted by Mrs. J. M. Labberton and Mrs. Crosby Field. Benjamin W. Webb of Philadelphia, Pa., played incidental music during the evening and later a large group gathered around the piano and sang popular and old-time songs.

Annual Tea Dance

The traditional Annual Tea Dance was held Monday evening in the Statler Georgian Room. This event, always popular, was this year attended by over 400 persons. Music for dancing and for individual table serenades was furnished by Jack Abrams and his orchestra. The yellow-chrysanthemum centerpieces on the large table contrasted beautifully with the gleaming silver candelabra. Tiny sandwiches and fancy pastries with assorted nuts and gaily decorated mints added to the beauty of the table and enjoyment of the affair. Mrs. H. R. Kessler was chairman of the tea dance, with Mrs. T. A. Burdick and Mrs. C. M. Hickox as vice-chairmen. The following poured at the tea:

Mrs. Frank W. Miller, Mrs. Roy V. Wright, Mrs. F. S. Blackall, jr., Mrs. R. J. S. Pigott, Jr., Mrs. Rudolph F. Gagg, Mrs. J. N. Landis, Mrs. C. B. LePage, Mrs. R. H. Bacon, Mrs. Clarence Hunter, Mrs. W. G. Waltermire, Mrs. J. A. Quaid, Mrs. Ralph Goetzenberger, Mrs. W. B. McNaughton, Mrs. Randall B. Purdy, Mrs. Ralph Morse, and Mrs. R. B. Adams.

Charleston Garden Breakfast

Activities on Tuesday started early with a breakfast at the B. Altman Company Charleston Garden, followed by a talk by Adelaide and Josephine Shaw, authors of "Simple Guide to Gift Wrappings." A representative of the Tie-Tie Gift Wrappings Company then gave a fascinating wrapping demonstration of "Colorful Christmas Packages." About 100 ladies attended this event at which Mrs. C. Higbee Young served as chairman, assisted by Mrs. George A. Harman and Mrs. John F. Kirby.

Tuesday Luncheon—UN Tour

The beautiful Beekman Room of the Beekman Towers Hotel was the scene of the luncheon on Tuesday, December 2. Christmas greens and candles decorated the tables. Mrs. R. B. Skinner, chairman, arranged for the luncheon, but due to her illness Mrs. W. E. Case took over her duties. Seated at the head table were Mrs. Case and her two assistants, Mrs. Norman F. Dahl and Mrs. Alexander J. Turpin, Mrs. U. A. Rothermel, Mrs. Frank W. Miller, Mrs. C. M. Hickox, Mrs. G. E. Hage-

Meetings of Other Societies

Jan. 12–15
American Management Association, general management meeting, Hotel Statler, Los Angeles, Calif.

Jan. 12–16
Society of Automotive Engineers, annual meeting and engineering display, Sheraton-Cadillac, Detroit, Mich.

Jan. 14–16
American Society of Photogrammetry, nineteenth annual meeting, Shoreham Hotel, Washington, D. C.

Jan. 19–21
Hydraulic Institute, The Homestead, Hot Springs, Va.

Jan. 19–22
The Plant Maintenance Conference and Show, Public Auditorium, Cleveland, Ohio.

Jan. 19–23
American Institute of Electrical Engineers, winter general meeting, Hotel Statler, New York, N. Y.

Jan. 21–23
Society of Plastics Engineers, ninth annual conference, Hotel Statler, Boston, Mass.

Jan. 25–31
The American Society of Heating and Ventilating Engineers, fifty-ninth annual meeting, Conrad Hilton Hotel, and the eleventh International Heating and Ventilating Exposition, International Amphitheatre, Chicago, Ill.

Jan. 26–27
International Organization for Standardization ISO/TC 62—Sheet and Wire Gages, London, England

Jan. 28–30
International Organization for Standardization, ISO/TC 52—Hermetically Sealed Metal Food Containers, London, England

Feb. 1–5
Associated Equipment Distributors, thirty-fourth annual meeting, Conrad Hilton Hotel, Chicago, Ill.

Feb. 4–6
IRE-AIEE, first Western computer conference, Hotel Statler, Los Angeles, Calif.

Feb. 16–21
American Institute of Mining and Metallurgical Engineers, one-hundred seventy-fifth general meeting, Hotel Statler, Los Angeles, Calif.

(*ASME Calendar of Coming Events, see page 90*)

AT THE PIERRE HOTEL TO ATTEND THE ANNUAL LUNCHEON
(*Left to right*, Mrs. Hickox Mrs. Rothermel, Mrs. Miller, and Mrs. Gibb.)

mann, sponsor of the Metropolitan Section, Mrs. H. R. Kessler, chairman of the Tea Dance, and the other chairmen of the Tuesday functions, Mrs. C. Higbee Young, Mrs. C. H. Kent, and Mrs. George Nigh.

At the beginning of the luncheon the entire gathering sang the "Spirit of ASME," led by Mrs. A. W. Thorson and accompanied by Mrs. Justin McCarthy, both of Philadelphia. Following the luncheon, Mrs. Peggy Fink Reiss, popular musicomedy and concert artist, entertained with several popular and classical songs.

Mrs. C. H. Kent and her assistants, Mrs. N. R. Fletcher and Mrs. John C. Somers, preceded the ladies in a short walk to the United Nations. The ladies were divided into groups and visited the various committee meetings. Many made a tour of the building. Most visited the gift shop and were intrigued by the products from the many nations which were offered for sale.

A Dream and a Memory

Tuesday's busy schedule of events ended with a coffee hour in Parlors A, B, and C of the Statler where the men and women enjoyed a beautiful, sound, colored movie, "A Dream and a Memory," presented by the Lurline featuring a trip to Hawaii, which many members plan to make immediately following the ASME Semi-Annual Meeting next June.

The movie was preceded by a delightful 45-minute musical program featuring Mrs. Ruth Bradley Jones, famous pianist, and Richard Cody, well-known baritone. After the movie, refreshments were served from a beautifully appointed table to the 200 guests attending. Mrs. George W. Nigh, chairman of the event, and Mrs. G. E. Hagemann poured. They were assisted by Mrs. John Hochuli and Mrs. William Byrne.

Annual Business Meeting

Wednesday, December 3, started with a breakfast at which Mrs. Frank W. Miller, president, was hostess to the Section chairmen or their representatives who were in New York at this time.

The annual business meeting was held at the Statler with Mrs. Miller presiding and about 150 members attended. Reports were presented by the Auxiliary officers, the chairmen of the Standing Committees, and the Section Chairman or her representative. The Auxiliary has sections in Boston, Buffalo, Chicago, Cleveland, Columbus, Detroit, Fairfield County (Bridgeport, Conn.), Los Angeles, Milwaukee, Minnesota, New York (Metropolitan), Philadelphia, Pittsburgh, Toledo, Washington, D. C., and the new section presently being formed, to be known as Iowa-Illinois.

Mrs. William E. Karg reported on the Calvin W. Rice Memorial Scholarship Fund. The scholarship this year has been raised from $750 to $1500 and was awarded in 1952 to Dante Cavalli, a brilliant young man from Italy who came most highly recommended.

Mrs. William E. Case reported that the Student Loan Fund has been most active this year. Twelve loans were made during the past year and three more are in process.

Mrs. R. L. Goetzenberger reported on the Sylvia W. Farny Scholarship Fund. This is a new fund in memory of Mrs. Sylvia W. Farny who was one of the pioneers in the formation of the Woman's Auxiliary Sections. It is a $500 scholarship awarded annually to an undergraduate in mechanical engineering based on character, scholastic achievement, and financial need. The first award will be made this forthcoming spring.

The treasurer's report, which is given in the Annual News Letter, states that the Calvin W. Rice Memorial Student Loan Fund contains $2,515.84; the Scholarship Loan Fund, $9964.47; the Sylvia W. Farny Scholarship Fund, $1347.11; and the General Fund of the Woman's Auxiliary $1943.62. These amounts are as of Oct. 1, 1952.

Distinguished guests at the meeting were Dr. Lillian Gilbreth; J. Calvin Brown, past-president, ASME, and Counselor to the Auxiliary; R. J. S. Pigott, retiring ASME president and Frederick S. Blackall, jr., newly-elected ASME president, and Mrs. Blackall, and Mrs. Roy V. Wright. Each of these guests spoke a few words of greeting. While they were present Mrs. Crosby Field presented the following motion: "I propose for Honorary Membership, Eliza G. Wright, member of the original ASME 'Ladies Committee' and member, ASME Committee Women, and president of its successor, the Woman's Auxiliary to the ASME; founding member, committee woman, and president of the Engineering Woman's Club; citizen, active in many community projects and Free-Holder, inspired author, wife of a famous Engineer and statesman, New Jersey State Senator, Roy V. Wright, and as his widow now carrying on his great tradition; mother of three accomplished daughters, and mother-in-law of three distinguished Americans. I move that Mrs. Wright be made an Honorary Member."

Mrs. Ralph Goetzenberger, Washington, D. C., seconded this motion which was then unanimously voted. Mrs. Frank W. Miller, president, thereupon presented to Mrs. Roy V. Wright a beautiful leather-bound certificate of honorary membership. Mrs. Wright responded graciously.

Mrs. W. T. Alexander reported for the Election Committee. The National Officers for the year 1953 are as follows: Mrs. Charles M. Hickox, president from New York, Mrs. W. E. Karg, first vice-president from Philadelphia, Mrs. U. A. Rothermel, second vice-president from New York, Mrs. J. V. Resek, third vice-president from Milwaukee, Mrs. T. E. Purcell, fourth vice-president from Pittsburgh, Mrs. E. R. Kaiser, fifth vice-president from Columbus, Mrs. T. A. Burdick, recording secretary from New York, Mrs. B. W. Taylor, corresponding secretary from Philadelphia, Mrs. C. H. Young, treasurer from New York, and Mrs. C. Gladden, assistant treasurer from New York.

Annual Luncheon and Fashion Show

The Roof Garden of the Hotel Pierre was the scene of the Annual Luncheon, the outstanding event of the Annual Meeting. A capacity crowd of 217 was present. The room was beautifully decorated with Christmas green, red berries, and red carnations. On the tables were green paper sleds containing a Shell Oil Company lucite pencil, a LaCrosse lipstick, a bottle of Pacquin's Silk and Satin Lotion, and a Thomas Collator Corporation scatter pin. These were donated by the manufacturers as were the Old Gold cigarettes.

Mrs. U. A. Rothermel, general chairman of the Annual Meeting presided. Honor guests on the dias were the following past-presidents: Mrs. Blake, Mrs. Boehm, Mrs. Purdy, Mrs. Gagg, Mrs. Stahl, and Mrs. Landis. Also on the dais were Mrs. C. M. Hickox, honorary chairman of the Annual Meeting and president-elect; Mrs. Frank W. Miller, retiring president; Mrs. John C. Gibb, chairman of the Annual Luncheon; and the two vice-chairmen of the Luncheon, Mrs. John Hochuli, who arranged the decorations, and Mrs. Sabin Crocker. Also Mrs. W. E. Karg, first vice-president of the Auxiliary, Mrs. H. R. Kessler, wife of the vice-president, Region II, and registrar at the Annual Meeting; Mrs. R. J. S. Pigott, Jr., daughter-in-law of the retiring ASME president; Mrs. Frederick S. Blackall, jr., wife of the president-elect of ASME.

The committee for the Annual Luncheon

CERTIFICATE OF HONORARY MEMBERSHIP IN THE ASME WOMAN'S AUXILIARY IS PRESENTED TO MRS. ROY V. WRIGHT, *left*, BY MRS. FRANK W. MILLER, NATIONAL PRESIDENT, AT THE BUSINESS MEETING HELD DURING THE 1952 ASME ANNUAL MEETING

included the following: Mrs. William H. Byrne, Mrs. W. W. Clinedinst, Mrs. Adolph Ebrecht, Mrs. William Hausmann, Mrs. William L. Iliff, Mrs. W. Bruce McNaughton, Mrs. Rudolph Schmidt, Jr., Mrs. Frances J. Sweeney, Mrs. E. J. Sharkey, and Mrs. H. E. Aldrich.

After the introduction of the head table by Mrs. Rothermel, Mrs. Miller introduced the hostesses at the various tables who were the chairmen of the various sections or their representatives, and Mrs. R. M. Nee, publicity chairman of the Metropolitan Section, Mrs. George S. Gethen of Philadelphia, National Expansion Chairman, Mrs. W. W. Clinedinst who assisted with the decorations. Mrs. Miller also gave a short history of the past-presidents of the organization. Mrs. Hickox, the new president, spoke a few words of greeting.

Mrs. John C. Gibb introduced Miss Lola Luxford, fashion director of the Hotel Pierre, who produced and presented the Fashion Show "Silver Wheat—At Home in America." The fashions were inspired by Reed & Barton's sterling silver flatware pattern, Silver Wheat. Gowns were by Fontana-Tafel; coats and suits by Glenhunt; separates by Nellie deGrab; sportswear by Lottie of Drewyn; dresses by Casper of Penart; blouses by Gregory; jewelry by Coro; gloves by Aris; bags by Majestic. Table decor—china and crystal by Plummer; table covering by Irish Linen Guild; and silver by Reed & Barton—arranged by Allyn Rice Bloeme. John Wallowitch, pianist, played during the luncheon and for the fashion show.

Following the fashion show there was a drawing for a beautiful handbag donated by Majestic Bag Company and for five other door prizes donated by the Metropolitan Section. Judging by the many comments heard after the luncheon this was one of the most gala annual luncheons ever held.

Steamship Tour and Buffet Luncheon

Thursday morning, December 4, about 150 people crowded into three buses and were taken to the United States Lines Pier, to make a tour of the SS *America*. Chairman of the tour was Mrs. Robert Cockrell, with Mrs. P. E. Frank, Mrs. Gordon Hahn, and Mrs. Donald V. Minard, assisting.

At noon the buses transported the ladies to the Town Hall Club for a sumptuous buffet luncheon. Among those on the dais were Mrs. R. W. Oakley, chairman of the luncheon; Mrs. Robert W. Cockrell; Mrs. Norman W. Wyckoff, chairman of the Lever House Tours; Mrs. P. E. Frank; Mrs. Frank W. Miller; Mrs. C. M. Hickox; Mrs. U. A. Rothermel; and Mrs. E. R. Kaiser of Columbus Section, who gave a program "Humorous Portraits" in costume. The ladies at the luncheon received as favors Fuller Brush lipsticks, a bottle of Charbert perfume, and Parliament cigarettes.

After the luncheon the buses carried over 80 of the ladies to Lever House where Mrs. Norman W. Wyckoff and her two assistants, Mrs. Chris J. Brous and Mrs. S. A. Cole, arranged for the ladies to inspect this fabulous new building.

Thus ended the events planned by the Metropolitan Section for the visiting ladies at the Annual Meeting. The Metropolitan Section of the Woman's Auxiliary to the ASME was very happy to be the hostess section this year and Mrs. Rothermel and her chairmen and committee workers trust that the visiting ladies returned to their homes with pleasant memories of the 1952 Annual Meeting in New York.

Reported by Mrs. U. A. Rothermel, chairman, Metropolitan Section.

Industrial Hygiene Foundation Annual Meeting in Pittsburgh

Air Pollution Conference

THE most important new aspect brought out at the Air Pollution Confetence held during the annual meeting of Industrial Hygiene Foundation at Mellon Institute, Pittsburgh, Pa., November 19, was the development of an extensive air-pollution problem in the rapidly expanding industrial Southwest.

As recounted by J. W. Hammond of the Humble Oil & Refining Company, Houston, Texas, the awareness of an air-pollution problem in Harris County came to the attention of the public and the lay press in June of 1952. This attention was obtained by a public hearing in Houston called by the State Health Department to receive complaints from civic organizations, clubs, and individuals living in areas of considerable air pollution. The Health Department's action was the result of a petition addressed to the Governor of approximately 5000 irate citizens for relief. Citizens' committees and civic clubs throughout Harris County claim to speak for 350,000 citizens protesting against an unreasonable level of air pollutants. A second hearing was held in August, 1952, under the same conditions to allow industry to express publicly its progress and future course of action in the field of abatement.

Air pollution build-up in Harris County has not been as gradual as in other industrial areas. For example, in 10 or 15 years Harris County has become the center of one of the largest chemical-producing areas in the world. Twenty years ago plants built in rural areas are today in thickly settled residential communities. The end of this expansion is not in sight.

At the first citizens' hearing, testimony was given that physical difficulties had been experienced by some members of the community. Also, there was testimony that damage had been done to property. To date, the problem has not been identified as a major health one. The general weather conditions and topography of the area are favorable to dilute large quantities of pollutants.

The local health departments with the cooperation of the State Department has recognized for several years that air pollution was a potential problem to some communities. Limited tests within the scope of the few public-health scientists in these organizations have been made for the past two years. They have visited industries to point out the problem and have recommended programs to minimize it.

Industrial leaders did not awake to the seriousness of this problem until the public hearings were called. Before, some individual industries had studied their plant's air-pollution sources and corrected some of them. Individual companies had spent as much as $3 million in research and equipment for air-pollution abatement.

In the summer of 1952, major industries organized into the Industrial Air Pollution Committee of the Houston Chamber of Commerce to attack voluntarily this problem.

The Committee informed industry as a whole and individually of its responsibilities and obligations in pollution abatement. Its primary objective was the promulgation and furtherance of an industry-wide program aimed to minimize both pollution of streams and atmosphere. This industrial association is seeking this end through education, business influences, mutual interest, and co-operation. Its basic thesis is that only as individual industries recognize their community relations, opportunities, responsibilities, and obligations in pollution abatement, can sound and practical solutions be effected. It believes without this statesmanship philosophy to govern industries in dealing with this problem, it will be impossible to avoid restrictive regulations being imposed. The concerted determination upon the part of industry to solve this problem was demonstrated by its employment of the Kettering Laboratory, University of Cincinnati, to make a preliminary investigation of air pollution in Harris County. This survey was begun in October.

Industries were contacted to determine their willingness to make such studies as were necessary to establish the extent of pollutants contributed by their plant operations. A compilation of the amount of research work that has been done and the amount of money that has been spent for the control of air pollutants was released. That survey revealed that during the years 1947-1952, more than $8,600,000 has been spent by industry for the installation of plants and equipment designed to eliminate atmospheric pollution, and approved plans have been made for additional expenditures of more than $6 million. The grand total of completed or projected expenditures related to air-pollution abatement by 57 companies reporting exceeded $13 million.

The survey by the Kettering Laboratory has been completed and will be released very soon. The survey team conferred not only with industry but with the city, county, and state health officials, U. S. Weather Bureau, the Houston Planning Authority, and reviewed the complaints of the citizens. The survey report will include recommendations on proper steps

to be taken by co-operating industries to find a solution of the Harris County problem.

The industrial companies will continue to work co-operatively through the offices of the Houston Chamber of Commerce. These same industries have been able to accomplish a great deal during the past 4 years in the field of liquid-waste abatement.

The Industrial Committee will encourage studies of public and municipal sources of air pollution. It will strive to eliminate every unnecessary source of pollutants, through a program of education, research, and community betterment. Its program and accomplishments are examples of how industry, through private initiative and civic leadership, can solve new and strange public nuisances created by the industrialization of a community.

Operations Research Society of America Holds First Meeting

OVER 400 scientists and engineers attended the first national meeting of the newly formed Operations Research Society of America, which was held at the National Bureau of Standards in Washington, D. C., Nov. 17-18, 1952, with representation from such diverse fields as industry, private and military scientific research, merchandising, and various nonmilitary government activities.

After an opening address by P. M. Morse of the Massachusetts Institute of Technology, president of the society and wartime director of operations research for the Navy, the meeting heard several papers on "The Monte Carlo Method."

Other papers discussed included the basic theory of "Waiting Times, Supply Lines, and Fluctuation Theory;" applications to the operation of single-track railroads, where trains headed in opposite directions can pass only when one of them is idle on a siding; the operations of seaports, where ships may suffer expensive waiting times if no berth is available when they reach port; and a paper on the programming of operations in an industrial production line.

The meeting featured a discussion panel, at which representatives of industry presented their sales and production problems to a group of operations-research experts.

Military applications of operations research were discussed on November 18 when a paper was presented which revealed a method for calculating the lifetime of such complicated air-borne equipment as the radar used in guided missiles. Representatives from the air force presented papers on the control of quality in the maintenance of aircraft and the development of planning procedures at the Air Proving Ground Command.

In a general session, a scientist of the Bell Telephone Laboratories told the group that people talk louder when telephoning a longer distance, explaining that speech volumes increase about one and a half decibels for every 1000 air-miles added to the length of the telephone connection.

The application of certain operations-research principles to marketing problems was discussed at the meeting, as well as the statistical effects upon university faculties of "academic tenure," the position of operations research in the management structure of industry, and the implications of certain work done by Thomas A. Edison during World War I, which employed concepts now used in operations research.

A special session was devoted to "Theories of Pay-Offs, Measures of Effectiveness, and Worth," at which the problem of how to select the proper criterion for weighing the value of different machines or methods was discussed. Illustrating the problem, it was explained that a method of destroying an enemy air base decreases in value if the method takes so long that planes from that base can do irreparable harm before their base is destroyed.

Lieut. Gen. Doolittle Announces Plans to Mark Airplane's 50th Birthday

PRESIDENT Harry Truman, President-Elect Dwight D. Eisenhower, and a list of prominent citizens have enthusiastically endorsed the proposal for a national, year-long celebration of the Fiftieth Anniversary of Powered Flight which started Dec. 17, 1952. Lieut. General James H. Doolittle is serving as chairman of the national committee which is developing plans for the observance.

The National Committee to Observe the Fiftieth Anniversary of Powered Flight was formed as the result of a national ground well among leaders of aviation and allied industries, government heads, the military services, and prominent citizens. It was the consensus that the nation should pause to honor the pioneers of flight, that few events in history have had greater significance in their ultimate impact on the social and economic development of the human race than that which took place at Kitty Hawk, N. C., on Dec. 17, 1903.

President Truman's endorsement was contained in a letter to T. W. S. Davis, acting chairman of the Air Co-ordinating Committee, and directed the interdepartmental committee "to develop and co-ordinate plans for the participation of the Government in the observance of this anniversary."

General Eisenhower wired General Doolittle, "Congratulations on becoming chairman of the Committee to Observe the Fiftieth Anniversary of Powered Flight. I agree with you that this is a worth-while project and one which can accomplish good for our country... I shall look forward to hearing more about the anniversary program."

Wallace Clark International Management Center Dedicated by NYU

THE Wallace Clark Center of International Management where students of international management techniques may study a "record of the past to serve the future" was dedicated Dec. 4, 1952, at the New York University.

The center established the scope of the University's Washington Square Center in the school of commerce, accounts, and finance through a gift from Mrs. Wallace Clark. Mrs. Clark donated the management library and records pertaining to the consulting concern in which she and her late husband were partners.

G. Rowland Collins, dean of the school of commerce, speaking at the dedication ceremonies, envisioned the center as a place where foreign management experts might gather when visiting this country, and as an orientation point for American management officials going abroad.

When and if funds become available, he added, the center may foster an "interchange of ideas" through the international exchange of teaching fellowships and exchange of students.

The new center includes facilities for seminars and conferences and the management library, foreign reports, and other records acquired prior to World War II by Mr. Clark.

Call for Applications for Freeman Fellowship

THE far-reaching aims of a famous American engineer, the late John R. Freeman, past-president of both ASCE and ASME, are being implemented once again by the offering of another Freeman Fellowship. The purpose of the present award remains the same as when the fellowships were established in 1924—to aid and encourage young engineers in promoting the science and practice of hydraulic engineering.

Alternately conducted by ASCE and ASME, the 1953 award for study or research project to be completed in 1954 is being arranged by an ASCE committee under the chairmanship of M. P. O'Brien, member of both societies. The committee has established the following rules:

1 Applicants must submit a program of study or research in hydraulics or related fields, covering a period of at least nine months starting in 1953. A statement of funds needed from the fellowship should accompany applications.

2 Applicants must furnish evidence of qualification to carry out the proposed program.

3 Applicants must be citizens of the United States and members in some grade of either of the two co-operating societies.

4 The Freeman Award Committee will give preference to projects bearing importantly on the defense effort.

5 Applications should be submitted to the Freeman Fund Committee, care of the Executive Secretary, ASCE, 33 West 39th Street, New York 18, N. Y., by Feb. 1, 1953. Announcement of the award will be made on March 15, and the recipient must make a report in English within 60 days of completion of his project

The maximum amount of grant from the Freeman Fund to a winning applicant has been $2500.

Coming Meetings

Plastics

THE program schedule for the ninth annual technical conference of the Society of Plastics Engineers, to be held Jan. 21-23, 1953, at the Statler Hotel, Boston, Mass., has been announced.

The titles of the papers, to mention a few, illustrate the wide variety of topics to be discussed in technical sessions pertinent to plastics: Professional training for the plastics industry, glass-bonded mica, plating and lacquering plastics, mold design and standardization, polystyrene—25 years of progress, plastics engineered for relief-map reproduction, reinforced polystyrene in aircraft, plastics for surgeons, engineering design for rubber phenolics, and many others.

General Doriot, president, National Research and Development Corporation, will discuss, at a luncheon meeting on January 23, the many phases of the plastics industry and forecast the progress of "Plastics—Engineered for Tomorrow."

Instruments

THE New York Section of the Instrument Society of America announced the plans for the sixth annual regional meeting to be held in the Penn Top suite of the Hotel Statler, New York, N. Y., Feb. 18, 1953.

The technical program consists of three sessions covering process instrumentation, power-plant instrumentation, and biological instrumentation.

The principal speaker at the banquet will be H. S. Bean, Fellow ASME, Chief, Capacity, Density, and Fluid Meters Section, Mechanics Division, National Bureau of Standards. The title of his talk is: "Future Research and Development in Fluid Metering."

Education

Materials-Handling Papers

RECEIPT of a gift of $5000 from the Wunsch Foundation, Inc., to establish a fund for annual prizes for the best student papers on materials handling has been announced by the New York University. The fund is to be known as the "Silent Hoist & Crane Company Materials-Handling Prize Award." A faculty board of review, appointed by Prof. David B. Porter, Fellow ASME, chairman of the college of engineering's industrial-engineering department, will conduct the competition and select the winners.

The field of materials handling is one of concern to engineers and industrialists because efficient materials handling is one of the most effective unexploited means of cutting production costs and time. This materials-handling prize award is intended to stimulate the interest of engineering students with special aptitudes in the art and science of materials handling.

IGT Announces Home-Study Course

THE Institute of Gas Technology is extending its educational services to the Gas Industry by bringing instruction, through Home-Study Courses, to students and utility employees who are unable to attend classes at the Institute.

The courses are being prepared in co-operation with the American Gas Association, which appointed a committee of utility executives to act in an advisory capacity. This co-operation, and the assistance of gas-industry specialists as contributors and reviewers, give the IGT Home-Study Courses a degree of authority and comprehensiveness seldom attained in works of this type.

The first of these courses, "Natural-Gas Production and Transmission," was written by J. D. Parent, dean of IGT.

The carefully considered plan adopted for the texts is to present the subject matter so it can be understood by persons with little or no training in the fields under discussion; yet, the coverage of all subjects is to be sufficiently comprehensive that the courses can be integrated with cadet engineering programs, and can serve as refresher courses for more experienced utility personnel. Chemical, physical, engineering, and geological fundamentals are offered early in the course, to aid those who have had no instruction in one or more of these subjects.

The student then progresses, in logical sequence, through each phase of production, gas conditioning, and transmission. Sections with advanced mathematical manipulation are so written that any person not familiar with the mathematics employed may omit the calculations, and by merely accepting the solutions as given, continue reading the sections with understanding.

Economic and legal aspects of certain operations are discussed in the chapters dealing with those operations. The closing chapters contain information essential to an understanding of the business activities (and problems) of natural-gas companies.

For further information inquire: Home-Study Courses, Institute of Gas Technology, 17 West 34th Street, Technology Center, Chicago 16, Ill.

Safety

THE spring term of the evening program in industrial- and traffic-safety training offered by the Center for Safety Education, New York University, begins Feb. 3, 1953. The expanded curriculum makes it possible for students enrolled for a full program during the fall to complete their course requirements for a certificate in either industrial or traffic safety. In addition, new students and students not working toward a certificate are eligible for enrollment in any of the courses.

Students may register for the spring term from Jan. 19 to 22 and from Feb. 2 to 6, 1953.

Instrumentation

THE preliminary announcements have been for the 1953 Instrumentation for the Process Industries Symposium, the eighth in the series to be presented by the school of engineering and chemical-engineering department, Texas A&M College, College Station, Texas, Jan. 28-30, 1953.

The subject matter is limited so that the primary emphasis is placed on applications to continuous fluid-flow processes. Particular attention will be given to new developments. The material will be on a practical engineering level; theory, when it is needed, will largely be given nonmathematically. The talks will be directed toward all engineers whose work requires knowledge of industrial instrumentation, that is, toward instrument, design, process, and operating engineers.

The entire proceedings of the symposium including both the papers and the discussion of them will be issued as a printed bulletin sometime after the course is completed.

AFS Melting School

THE American Foundrymen's Society annual melting school will be conducted March 16 to April 2 at the University of Illinois' Chicago Undergraduate Division. Sessions will be from 6:30 to 9:30 p.m. Monday through Thursday during the three weeks of the course. Roy W. Schroeder, assistant professor of foundry and pattern laboratory at UIC and chairman of the Educational Committee, Chicago chapter, AFS, will act as director of the school.

The school will again be divided into four groups: gray iron, steel, malleable, and nonferrous. Steel meetings will be on Mondays, gray iron on Tuesdays, malleable on Wednesdays, and nonferrous on Thursdays. The steel group will meet from 6:30 to 9 p.m. and the other groups from 7 to 9:30 p.m.

Railroad Papers Invited

The list of awards for railroad technical papers to be presented at the eighth Pan-American Railway Congress when it meets in Washington, D. C., June 12-20, 1953, and Atlantic City, N. J., June 21-25, 1953, were announced by the organizing committee for the congress.

The list includes the Eric V. Hauser Memorial Award of $1000 for the paper judged to be the most helpful to the science of railroading in respect to way and structures; three prizes totaling 50,000 pesos (about $3600) for the authors of papers on railroad subjects have been offered by the Argentine Government. These awards include 25,000 pesos for the best paper on railroad planning and co-ordination; 15,000 pesos for the outstanding paper on railroad operation, and 10,000 pesos for the best paper on social and working conditions of personnel; the Pan-American Railway Congress Association has also established an award of 25,000 pesos (approximately $1800) and a gold medal for the paper which is of the most positive benefit toward the operation and economy of railroads. This award will be a memorial to Santiago Brian of Argentina, founder of the Pan-American railway organization and an outstanding railroad engineer.

All papers prepared by Americans should be submitted in triplicate to Lewis K. Sillcox,

executive vice-president, The New York Air Brake Company, Watertown, N. Y.

Mechanical Design Award

A NEW competition for designers, engineers, and manufacturers of machinery of all types has just been announced by The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio. The new $30,000 Mechanical Design Award Program offers $30,000 in 101 cash awards, as well as national recognition, for the best papers describing the mechanical design and construction of any type of machine or machine component which is designed for arc-welded steel fabrication.

Any machine or component whose performance or appearance has been improved or whose cost has been reduced through the use of arc welding in its construction can be described. Any person who has participated in the designing, planning, or manufacturing of the machinery can compete in the program by describing his work. A total of $20,100 will be given in 54 awards in 18 different divisions comprising 18 First Awards of $500, 18 Second Awards of $250, and 18 Third Awards of $150, plus 39 Honorable Mention Awards of $100. Each Division offers a separate competition. A total of $9900 will be given in Grand Awards to the 8 best-of-the-program papers. All papers are eligible for both Divisional and Grand Awards. Top award is $2000, plus $500 First Divisional Award.

Papers may describe machinery in any of the following 18 classifications: Metal cutting, metal forming, electrical, conveying, pumping and compressing, prime movers, jigs, fixtures, and tooling, processing, construction and mining, petroleum and gas, metal making and refining, textile and clothing, farming and ranching, food and fiber products, woodworking, lumbering, and milling, household, printing, and machinery not otherwise classified.

The foundation states in the Rules Brochure for the program that it is sponsoring the program to stimulate the scientific advance of machine design through the wider use of arc-welded construction.

The program closes July 27, 1953. The Rules and Conditions brochure is available from the Lincoln Foundation, Cleveland 17, Ohio.

Corrosion

A FIVE-DAY short course in corrosion will be held Feb. 2–6, 1953, at the University of California, Berkeley. The course is given by the university's extension department and the departments of mechanical engineering, mineral technology, and chemical engineering in co-operation with the National Association of Corrosion Engineers.

Speakers from industrial and governmental laboratories and academic institutions will cover basic corrosion science theory and application of corrosion-mitigation measures. Discussions will cover construction materials, coatings, environment, cathodic protection, corrosion testing and evaluation, equipment design, high-temperature oxidation, and the role of the corrosion engineer in industry.

ICS Revises Courses

A COMPLETELY revised text on heat-treatment of iron and carbon steel has been added to International Correspondence Schools courses in toolmaking, industrial metallurgy, and heat-treatment of metals.

This new edition has been revised with emphasis on new procedures and compositions of different steels. Covered in the text are heat-treatment, physical and structural changes, effect of cooling rate on transformation points, and heat-treatment of low, medium, and high-carbon steels.

A new text on management of refrigerating machinery is now included in ICS courses in refrigeration, refrigeration and air conditioning, and stationary refrigeration.

Subjects covered in this new text are: Starting of compression plants, operation of compression machinery and its maintenance, management of Freon plants, types of bearings, and bearing troubles and remedies. The latest available illustrations of compressors with description of operation are included.

These new textbooks are also available under the ICS Selective Plan which permits employers to select only those subjects required to achieve specific training objectives for certain picked personnel.

Applications Available for 1953–1954 NSF Graduate Fellowships

ANNOUNCEMENTS and applications for the Second Graduate Fellowship Program of the National Science Foundation are now available to students all over the United States who would like to apply for awards for graduate study during the 1953–1954 academic year in the mathematical, physical, medical, biological, and engineering sciences. Fellowships are limited to citizens of the United States.

Applications for the current NSF fellowship awards may be obtained from the Fellowship Office, National Research Council, Washington 25, D. C. Completed applications must be returned by January 5, 1953.

Junior Forum

Conducted by Joseph Schmerler[1]

S. B. Irelan Talks on Steps to a Successful Career

THIS year, in celebrating the one hundredth birthday of the country's first engineering society, many of the older members of the profession have paused to reflect upon the changes which have occurred in engineering during their careers.

Established engineers find amusing the difficulties encountered during their early years. Also, this view in retrospect focuses their attention on some of the fundamental character traits and professional approaches which aid in a successful career.

A recounting of such experience was given at the annual dinner of the Engineers Club of Bartlesville, Okla., on Oct. 14, 1952, by S. B. Irelan, president, City Service Oil Company.

Engineering Problems Cited

Mr. Irelan said that except for the problems of getting money for new capital expenditures, which is always with us, the problems that stumped us then and were very real, seem absurd now. He stated further:

"There was, for example, the problem of Saturday night. In those days Saturday night, even more than now, was everybody's night to howl. And they wanted to howl in the full glare of Mr. Edison's great invention. Every light in every residence blazed bright on Saturday night; streetcars clanged and rumbled along with full loads; shoppers eddied in and out of stores and gawked at shop windows. The town was full of vim and bathed in incandescent brilliance. Bathed up to a point, that is, up to the point when weakened tubes in our straining boilers at the power plant, roaring at capacity to meet the peak load, would begin to blow out by the dozen. Then steam pressure would drop, the generator's whine would die away, and all over town man-made radiance would give way to darkness through which irate merchant and indignant housewife would grope to telephones to complain of the service we were giving.

"But our river water was a mighty trial to a water-tube boiler. Salt condensates formed stalactites and stalagmites that would have been a tourist attraction in any cave; boiler tubes pitted overnight. Natural-gas burners were primitive and erratic and gas with fluctuating pressure and liquid content caused a surging action that was death to boiler walls.

"Eventually, of course, we cured the water problem with recirculating and treating basins; ways were found to process gas and to control pressure; burners were improved and Saturday night gradually ceased to be a headache. But we learned the hard way.

"Early-day electric refrigerators provided their share of annoyance, too. The refrigerant was a sulphur compound which leaked, spoiling food, tarnishing everything it touched. When the automatic switch came on, the single-phase motor started, the belt drive on the

[1] Design Engineer, Celanese Corporation of America, New York, N. Y. Jun. ASME.

gas compressor slipped, back pressure from the compressor stalled the motor and combative customers and frustrated engineers were a dime a dozen.

"Street car lines, with return circuits inadequately maintained, distributed electricity pretty generally over the city gas and water systems and effects of the resulting electrolysis did not endear the operators to annoyed city officials.

"But such early and now slightly absurd engineering problems spurred the developments that have given us the near-perfection of performance that characterizes service apparatus in all phases of manufacturing and production today.

"For one reason only do I mention those simple problems over which we furrowed our brows far from professors to consult and without much help from available textbooks. The reason is to point to the seven-league boots which engineers now wear as they stride across new thresholds.

Shortcomings of Engineers

"That happy conclusion brings me to a consideration of some of our shortcomings with which we have had to wrestle. The truth is—and a sad truth it is for many of us—that the primary importance of his profession has made the engineer the social lion of an involved modern system we call civilization. He has not sought that distinction; indeed, many times he has squirmed and sulked and attempted vainly to ignore it. But it has been thrust upon him because of his unique ability to conceive, to create, and to operate the sometimes terrifying industrial complex called into being as the servant of mankind.

"And so—like it or not—for his own sake, he must learn to play the part. Top industrialists call upon engineers to point the way to a better world for businessmen and consumers alike. They exhort the engineers to become articulate leaders to even higher plateaus of civilization.

"In the past 43 years it has fallen to my lot to hire and to assist in the training and use of the talents of hundreds of men who got their BS in engineering. They all had the advantage of a specialized education that taught them to explore, to analyze, and to reach sound conclusions. But many of them exhibited educational gaps that limited their usefulness and lessened their capacity to forge ahead in their careers.

"Ever since you read your first copybook maxim it had been drummed into you that a man gets ahead in life by 'push.' Let me shatter an illusion: A man gets ahead by 'pull.'

Creating Favorable Impression

"Now, before you jump to the conclusion that I am suggesting that you should marry the boss's daughter, let me add that you acquire pull as you make favorable impressions on the other fellow. There isn't really any such thing as a "self-made man." A lot of people help make us all. They help because they have confidence in us. You go up the ladder because somebody in a position of authority decides you are ready for the next rung; somebody helps you get promoted because he is favorably impressed.

"I'll admit without debate that somebody is prepared to be favorably impressed by your engineering ability. But people gain many impressions of us—not just one. How about some of the other impressions you give. For example:

"How's your handwriting? Do you write legibly, or do you blame your undecipherable scribbling on the hurried tests you had to take in school and comfort yourself by reflecting that nobody can read Einstein's writing, either?

"What about bookkeeping? Do the terms debit and credit mean anything to you, or do you think one is something you get at the grocery store and the other something you take care of on payday? If you can't read a balance sheet or an earnings statement, you'd do well to learn.

"What about corporate organization and financing? Can you analyze the net worth of a company and evaluate its securities? If the answer is no, you wouldn't be much help in a prospective purchase or merger.

"Are you articulate? Can you get on your feet before a group and make a lucid coherent presentation, or are you tongue-tied before an audience? Can you explain and sell an idea in a written report, or do words fail you when you need them most?

"Are you a salesman? Whether you think of yourself as a salesman or not, you sell *something* to *somebody* every day of your life—or you fail to sell it. You'd better *learn* the rudiments of making a pitch.

"Are you poised and pleasant? Are you affable, courteous, and well-met, or aggressively blunt, gruff, and sour? Erudition is invaluable, but you can be an intelligent failure if you alienate and offend everybody you meet.

"Are you personally presentable? Whoever first said that "clothes don't make the man" did his fellow men a disservice. A millionaire or a bum may disregard grooming with impunity, but the rest of us need to remember that many a Phi Beta Kappa and Tau Beta Pi has paid dearly for a frowzy, unkempt appearance.

"Do you take part in public and civic affairs? Business and industry today are looking for capable employees—but they're looking for good citizens, too. Business is keenly aware of its obligations to community and government; it expects employees to be aware of their obligations, too.

"Do you exercise self-discipline? Intemperance doesn't necessarily refer to the consumption of too much alcohol, although it may. But you can ruin a potentially brilliant career by drinking too much, eating too much, playing too much—or even working too much.

"Balance, moderation, and control in your personal habits will help you to become master of yourself and consequently, to an extent at least, of your course in life.

First-Rate Performance Necessary

"I may have left the impression that the world expects more of you than it should. I don't mean to. Having received so much from the hands of its engineers, society naturally is prepared to receive even more—and to give back rewards in keeping. So I have really been talking about opportunity rather than duty. Don't pass up opportunity at any stage of your life. With your trained mind and solid foundation in science, put on a first-rate performance, and you have every right and reason to see to it that your performance pays off at the box office."

1953 ASME Council Organized

At a Meeting at the Hotel Statler, Dec. 1, 1952

THE organization meeting of the 1953 ASME Council was held on Monday evening, Dec. 1, 1952, at the Hotel Statler, New York, N. Y. R. J. S. Pigott, president 1952, called the meeting to order, introduced the newly elected members of the Council, and presented the "President's Gavel" to F. S. Blackall, jr , president 1953, who then took the chair.

Certificates of Appreciation

Certificates of appreciation were presented to the retiring members of the Council. A vote of thanks and appreciation of the achievements of Mr Pigott as President was recorded, and the special President's emblem was presented to him.

Appointments

The Council voted the following appointments to run for one year: C. E. Davies, secretary; Joseph L. Kopf, treasurer, Edgar J. Kates, assistant treasurer; and Joseph L. Kopf, treasurer of the Development Fund.

The Executive Committee for the administrative year 1953 was constituted as follows: Frederick S. Blackall, jr., chairman, Harold E. Martin, Albert C. Pasini, Ernest S. Theiss, and Willis F. Thompson.

The following assignments of directors to Boards and Committees were authorized: B. P. Graves, Board on Codes and Standards; P. B. Eaton, Board on Education and Professional Status; L. J. Cucullu, Board on Honors; D. W. R. Morgan, Board on Membership; R. L. Goetzenberger, Board on Public Affairs; A. C. Pasini, Board on Technology; T. E. Purcell, Organization Committee; and H. E. Martin, Finance Committee.

The Council Committee on Staff Personnel was constituted as follows: J. M. Todd, chairman, H. E. Martin, W. F. Thompson, H. R. Pearson, and A. C. Pasini.

Functions of Boards

The Council delegated certain functions to the Boards on Technology and on Codes and Standards.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th Street	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

Men Available[1]

Mechanical Engineer, experienced steel fabrication, production, welding on pressure work. Desires new connection in interesting work. Familiar with costs, standards, estimating, and industrial engineering. Prefers Southwest. Me-922.

Mechanical Engineer, 28, presently employed utility-plant design. Three years' experience design and development, four years assistant to consultant engineer. Desires position with greater personal responsibility. New York area. Me-923.

Manufacturing Engineer — Plant Manager, 25 years' experience in aircraft electronics, general machine, and ordnance work. Proved ability in all phases of management and production. Outstanding practical shop experience, tooling, design, methods. Me-924.

Mechanical Engineer, graduate, registered engineer-in-training, desires position as assistant plant/project engineer. Chemical/process industry. Two and a half years' experience plant and material-handling equipment—project work, building surveys, design, installation. Knowledge engineering economy, purchasing, accounting. Studying master's industrial management. Me-925.

Executive, BSE, ME, 39, married, family, presently employed as executive vice-president, small company. Sixteen years' experience as engineer, plant manager, salesman, and executive in chemical, mining, and process industries. Me-926.

Production Engineer, 31, five years' experience co-ordinating engineering and manufacturing functions by economical solution of problems in tooling, methods, liaison, procurement, production control, and personnel. Desires New York City area. Me-927.

Plant or Chief Engineer, mechanical degree, several years' experience in appraisals, design, construction, plant layout, heavy and light machinery and equipment installations. Power-heating and air-conditioning surveys including design and installations. Assume all duties as plant engineer. New York metropolitan area or South. Me-928.

Mechanical Engineer, 28, four years product design and development, two years marine power-plant maintenance. Supervisory and administrative experience. Willing to relocate. Me-929.

Positions Available

Associate Professor, mechanical engineering, some teaching and industrial experience. PhD desired, master's acceptable, 33-50, to teach thermodynamics, heat power; conduct research part time. $5500-$7000, nine months. Del. Y-7369(*c*).

Product-Development Engineer, electrical or mechanical, industrial experience in engineering and administration. Position will lead to responsibilities of chief engineer for development operations and manufacturing specifications in smaller company manufacturing precision electromechanical products for electronic industry. $5000-$10,000. Upstate N. Y. Y-7841.

Engineer. (*b*) Mechanical engineer, ten years' or more design and installation experience covering heat-transfer equipment and accessories. $8000-$10,000. Must be citizen. New York metropolitan area. Y-7851.

Director of Development Engineering in the field of heavy custom-design machinery. $20,000. New England area. Y-7853.

Product Engineer, 25-35, mechanical graduate, manufacturing experience, for product design and development involving direct contact with customers, production departments, and research laboratories in technical and industrial glassware fields covering piping, pumps, and textile equipment. $5000-$6000. Western N. Y. Y-7859.

Machine Design Engineer, mechanical or equivalent, minimum of seven years' experience in design work on medium or heavy automatic machinery, for manufacturers of various types of presses, including die cutting, and creasing, embossing and metal forming up to 400-ton capacity; also bookbinding machinery such as binders, coverers, casemakers, etc. $7000-$10,000. Northeastern N. Y. Y-7862.

Tool and Die Designer, 35-45, at least five years' experience in die design of light-metal stamping and forming variety. Knowledge of progressive dies. Will design stamping and forming dies for light-metal manufacturing. Will understudy chief engineer who retires in about three years. Some customer contact for a manufacturer of metal products. $6000-$10,000. Company will negotiate placement fee. Ill. Y-7863-T-9348.

Plant Manager, 35-40, preferably mechanical or industrial graduate, to operate 600 to 800-man plant, producing light fabricated metal products. Someone who has had ten or more years' experience in the light-metal industry, and at least five years in a supervisory position. Up to $10,000, or higher. Conn. Y-7868.

Engineers. (*a*) Product-development engineer—sheet-metal designer on staff of the products engineering, for manufacturer of heating, ventilating, air-conditioning, and heat-transfer equipment. Should have good understanding of shop fabrication and tooling methods. Will work with, supervise, and guide design draftsmen in the direction of basic design of parts and assemblies for low production costs. $8000-$12,000. (*b*) Manufacturing executive, to 50, 15 to 20 years' of varying production experience; experienced tool designer; good knowledge of plant layout, flow of materials, and production methods. Prefer graduate with engineering degree, for manufacturer of air-conditioning, heating, and refrigeration units. Will be responsible for entire planning of the production department, i.e., planning of tooling, methods improvement, machinery improvement with the objective of cost reduction. $10,000-$15,000. Midwest. Y-7869.

Mechanical Engineer, 25-30, graduate, for design research and development of complete facilities in power and process planning. Should have firm grasp of the theory and some practical experience in thermodynamics and applied mechanics. Special staff position with long-established engineering and consulting organization. $6000-$7000. Eastern Pa. Y-7878.

Process Engineer, 38-44, mechanical-engineering background, to make models of photocopy machines from the experimental and model shops, engineer them, write specifications and bills of materials, and see that necessary drawings are made for production. Experience in office-equipment or photographic-equipment fields helpful. $13,000. Mid N. Y. State. Y-7897.

Chief Executive Engineer, mechanical or electrical-engineering degree, 15 or 25 years' experience in machine-tool, dies, and jig design. Complete familiarity with production methods and tooling. Must be capable of setting up and controlling all functions of engineering department. Salary open. Westchester County, N. Y. Y-7934.

Machine Designer, 25-50, who also can take charge of methods and time study. Should have five years' experience in machine shop, five years in machine design, and five years in some type of industrial engineering. Work will be the redesign of a line of sheet-metal fabrication machines, i.e., benders, cutters, trimmers, etc. $8000-$9000. Conn. Y-7944.

Mechanical Engineer, 30-40, at least five years' experience covering general engineering, maintenance, and instrumentation experience in textile or allied fields, to take charge of projects, prepare estimates, and supervise installation of equipment in mill and power plant. $6500-$8500. Southern Va. Y-7951.

Manufacturing Engineer, graduate, 30-35, to head up manufacturing operations for instrument components as used in aircraft industry. Company manufactures only certain components, and subcontracts and procures others from other manufacturers. $8000-$10,000. N. Y. metropolitan area. Y-7955.

Quality-Control Manager, graduate, thoroughly experienced in the techniques of statistical quality control for mass-production industry. $10,000-$12,000. N. Y. metropolitan area. Y-7956.

Engineers. (*a*) Vice-president for sales 38-50, for multiplant manufacturing operation producing several related medium-heavy industrial-product lines for distribution through three separate sales organizations. Must have experience in full personal charge of sales, building a complete selling organization, pricing and setting terms and discounts, training salesmen, developing effective sales controls, etc. (*b*) Works manager, 40-50, for plant manufacturing light industrial equipment requiring extensive foundry and machining operations. Must have current experience as a successful works manager or assistant works manager in a medium-sized plant engaged in light industrial manufacturing. Extensive experience in metal fabricating and assembly, sound understanding of complex foundry operations, thorough knowledge of modern manufacturing control techniques, including cost, quality, and production control, etc. Mechanical graduate preferred. $15,000-$20,000. N. Y. State. Y-7963.

Mechanical Engineer for estimating and taking off quantities on heating, ventilating, and plumbing for foreign construction job. Should have ten to 15 years' experience. $10,000, plus bonus on completion of job, plus living allowance of $400-$450 a month for married man with family; or $300 a month single status. France. Y-7969.

Plant Chief Engineer, 32-45, two years' university training, and five years' experience in high-pressure steam-electric generating station and associated auxiliary equipment. Knowledge of all phases of modern high-pressure steam-electrical generating plant. Will take complete charge of 25,000-kw two-unit plant, in operation, maintenance, and all personnel, for electric utility. $5400-$6000. Employer will negotiate fee. Texas. T-9381.

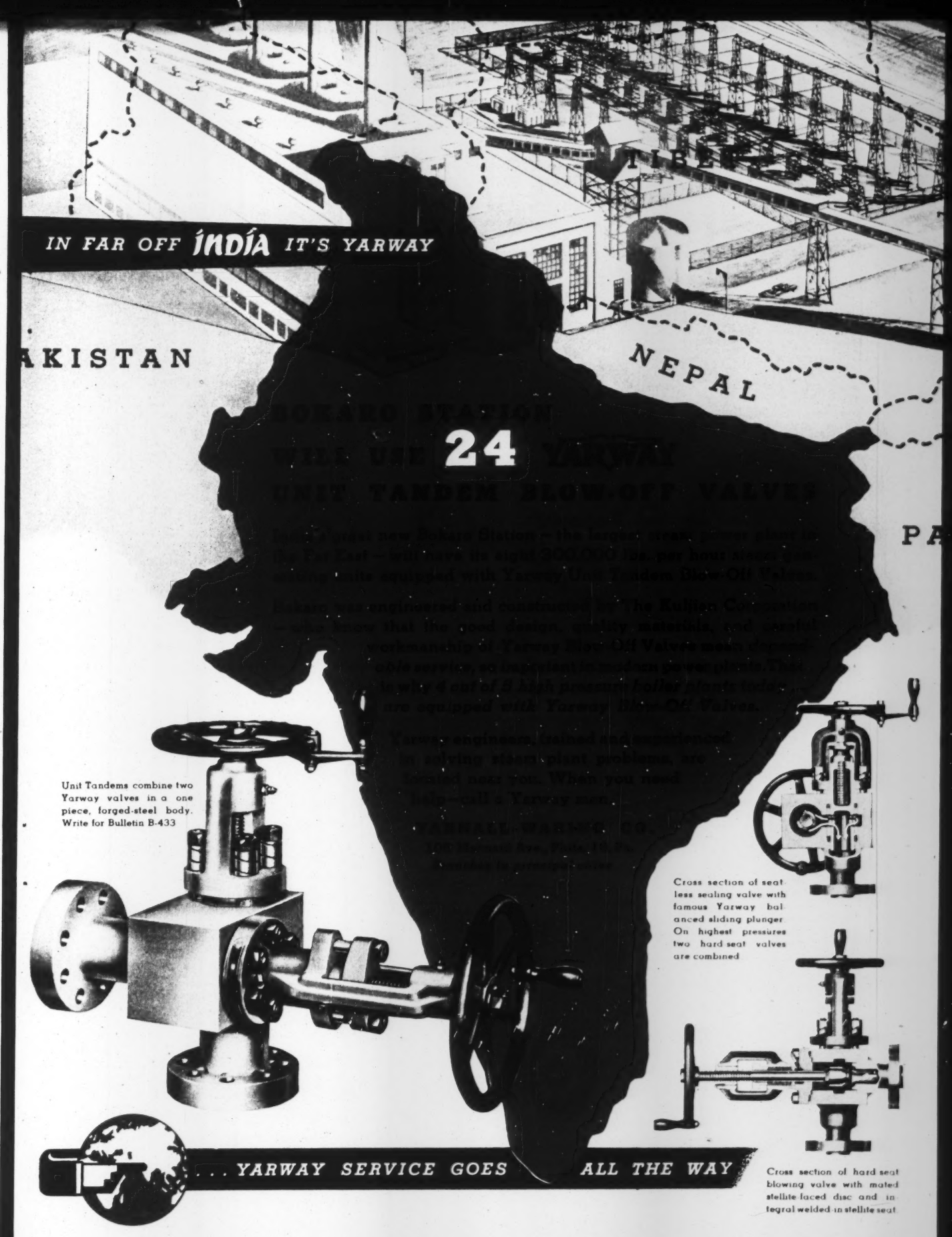
Editor, degree in engineering, 40-55, five years' experience in technical editing plus broad experience in industry or consulting engineering. Will organize and supervise editorial departments for industry and power and consulting engineering magazines. Will write editorials and articles and make editorial contacts, plus some advertising contacts from editorial approach. Set up and maintain editor-cost controls. Must have knowledge of make-up (magazine) and engravings. $10,000, and up. Employer will pay fee. Mich. T-9386(*a*).

Theoretical Applied Mechanics Research Engineer, up to 45, PhD degree. Must be strong on stress analysis and able to pass rigid physical. Will do high-level research work in applied mechanics for a refinery. Up to $12,000. Ill. R-9368.

Foundry Superintendent, 35-55, ten years' experience in nonferrous foundry supervision. Knowledge of aluminum sand-casting work. Will direct production of aluminum foundry with

(*ASME News continued on page 104*)

[1] All men listed hold some form of ASME membership.


IN FAR OFF INDIA IT'S YARWAY
TIBET
AKISTAN
NEPAL
PA
BOKARO STATION
WILL USE 24 YARWAY
UNIT TANDEM BLOW-OFF VALVES
India's great new Bokaro Station — the largest steam power plant in the Far East — will have its eight 300,000 lbs. per hour steam generating units equipped with Yarway Unit Tandem Blow-Off Valves.
Bokaro was engineered and constructed by The Kaiser Corporation — who know that the good design, quality materials, and careful workmanship of Yarway Blow-Off Valves mean dependable service, so important in modern power plants. That is why 4 out of 5 high pressure boiler plants today are equipped with Yarway Blow-Off Valves.
Yarway engineers, trained and experienced in solving steam plant problems, are located near you. When you need help—call a Yarway man.
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100 Mermaid Ave., Phila. 18, Pa.
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Cross section of seatless sealing valve with famous Yarway balanced sliding plunger. On highest pressures two hard seat valves are combined
Cross section of hard seat blowing valve with mated stellite faced disc and integral welded-in stellite seat
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about 80–100 employees. $7200–$8400. N. J. R-9384.

Chief Engineer, BS, 30–45, about ten years' experience, preferably aircraft engine, heavy in design, and administrative experience. Knowledge of manufacturing engineering; ability to design, do testing, and instrumentation technique. Chief engineer of aircraft division of automotive manufacture. Report directly to vice-president. Able to contact vendors and customers and meet the public. $18,000–$25,000. Some traveling. Company will negotiate fee. Mich. R-9405(a).

Product Designer, mechanical engineer, 30–45, five years' experience in design of home appliances and medium electrical-mechanical devices. Knowledge of manufacturing techniques and processes. Will do product design and development of small home appliances for a manufacturer. Up to $13,000. Employer may negotiate fee. Ill. R-9416.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Jan. 26, 1953, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

NEW APPLICATIONS

For Members, Associate, or Junior

ACKERMAN, MERVIN R., Chicago, Ill.
AIHARA, KUNIAKI, New York, N. Y.
ALLEN, CLAUDE V., Richmond, Va.
AMBROSE, EVERETT J., JR., Springfield, Mass.
ANDERSON, JOSEPH C., Seattle, Wash.
BARKER, ORRIN W., Waukesha, Wis.
BLEICH, HANS H., New York, N. Y.
BRAMHALL, RICHARD A., York, Pa.
BROWN, CHARLES L., New York, N. Y.
BUFFA, ELWOOD S., Los Angeles, Calif.
CHENEA, PAUL F., Lafayette, Ind.
CICI, THOMAS J., Olean, N. Y.
COE, ROBERT, La Crosse, Wis.
COZZENS, DONALD A., East Meadow, L. I., N. Y.
DADHE, D. G., Poona, India
DATTA, NIRMAL ENDU, Brockley, London, England
DOUGLASS, ROBERT M., Baltimore, Md.
DURRENBERGER, J. E., Las Cruces, N. Mex.
EASTON, OZA A., Angleton, Texas
ECHLMAN, ROBERT I., Rochester, N. Y.
ECKERT, ERNEST J., Vernon, Calif.
ESCHENBRENNER, GUNTHER P., New York, N. Y.
EWALT, NEWTON, New York, N. Y.
FILO, FRANK A., Milwaukee, Wis.
FISCHER, EDWARD G., E. Pittsburgh, Pa. (Rt&T)
FISHER, EDWIN S., New York, N. Y.
FORUNET, MAURICE B., JR., Angleton, Texas
FOSTER, MORGAN L., Cambridge, Mass.
FRASER, GROVER D., Painted Post, N. Y.
FREULER, FRED H., Wilmington, Del.
FRY, FREDERIC S., Englewood, Colo.
FURLONG, GEORGE L., JR., Roseton, N. Y.
GIEDT, WARREN H., San Francisco, Calif.
GLICKMAN, LESTER, Newport, R. I.
GREY, JOSEPH C., JR., Great Falls, S. C.
GROSSU, MIRCEA, Youngstown, Ohio
GRUBER, THOMAS J., Martins Ferry, Ohio
HANFORD, WILLIAM T., East Islip, N. Y.
HANSEN, ROBERT R., Davenport, Iowa
HEMMERSMEIER, CONRAD, St. Louis, Mo.
HEMSWORTH, MARTIN C., Cincinnati, Ohio
HENDERSON, STANLEY D., North Quincy, Mass.
HICKS, DONALD E., Detroit, Mich.
HOAG, CLARENCE B., Syracuse, N. Y.
HOLZAPFEL, PETER, Johannesburg, South Africa
HOWARD, G. W., Cap Haitien, Haiti
HOWES, FREDERICK M., Salt Lake City, Utah
HUNTER, EDMUND J., JR., Thomasville, Pa.
ILIINE, ANDREW S., Cincinnati, Ohio
JAMES, DAVID H., Huntsville, Ala.
JOHNSON, LEIGHTON W., Portland, Ore.
JOHNSTON, THOMAS L., New Castle, Pa.
JOHNSTONE, RONALD C., Cape Town, South Africa
JONES, PAUL C., Roanoke, Va.
JUHASZ, STEPHEN I., Cambridge, Mass.
KEI, SIGMUND ELI, Brookline, Mass.
KIESWETTER, HAROLD C., Fort Erie, Ont., Can.
KNOX, CLIFFORD J., Fitchburg, Mass.
KOHLER, W., Kankesanturai, Ceylon
KOLZE, LAWRENCE A., Bensenville, Ill.
KONIGES, FRANK L., New York, N. Y.
KOWITZ, MARTIN J., Wyandotte, Mich.
KUTSCH, HOWARD J., Wilmington, Del.
LAMBINE, OSCAR M., East Walpole, Mass.
LANGE, WILLIAM F., Springdale, Conn.
LARSEN, WALTER C., Ridgefield, N. J.
LEVEY, HORACE B., Bloomfield, N. J.
LINN, SIDNEY S., New York, N. Y.
LYNCH, JAMES E., Corvallis, Ore.
MARLEY, WALTER M., York, Pa.
MARTIN, SAMUEL W., Stamford, Conn.
MASINO, A. A., Trenton, N. J.
MAYNARD, RALPH T., York, Pa.
MCDONOUGH, ROBERT P., Lockport, N. Y.
MERCHANT, CHARLES H., Springfield, Ill.
MILLER, CHARLES E., Schenectady, N. Y.
MOUNTZ, ROBERT F., Texarkana, Texas
MUKERJI, ANADI PRASANNA, Kanpur, U. P., India
MURPHY, WILLIAM G., JR., Great Neck, L. I., N. Y.
MUSSCHOOT, ALBERT, Park Ridge, Ill.
MYERS, CORBIN H., Los Angeles, Calif.
NAHIGYAN, KEVORK K., Valley City, Ohio (Rt&T)
NIEBUHR, VICTOR G., Greenwood, Mass.
NIPPES, ARTHUR S., Jeannette, Pa.
NOBLE, GEORGE A., Alliance, Ohio
NOTTOLI, GENE A., Hammond, Ind.
OLSEN, HOWARD W., JR., Independence, Mo.
PARKERSON, W., Chicago, Ill. (Rt)
PARMELEE, GEORGE V., Cleveland, Ohio
PATTON, EDMOND S., Pittsburgh, Pa.
PETERSEN, KNUTE L., Glenview, Ill. (Rt&T)
PFERSDORFF, O. H., Caracas, Venezuela (Rt&T)
PLANT, PAUL R., Boston, Mass.
POWELL, GEORGE G., Toronto, Ont., Can.
PRESTON, WALTER E., JR., Kansas City, Mo.
PRINTZ, RALPH L., Pittsburgh, Pa.
PUFFINBARGER, ARTHUR R., Riverton, Kan.
PUGH, WILLIAM H., Lakewood, Ohio
QUIN, FRANK W., JR., Shreveport, La.
RAAE, ALFRED, New York, N. Y.
RADZKA, BENJAMIN, New Hyde Park, L. I., N. Y.
RASMUSSEN, OTTO R., Bridgeport, Conn.
REES, DONALD R., Detroit, Mich.
RING, JAMES H., Milwaukee, Wis.
ROGIN, SIDNEY M., Detroit, Mich.
ROSS, JAMES E., Lake Jackson, Texas
RUSSELL, WINSLOW H., Glen Rock, N. J. (Rt&T)
SAHAI, CHATURBHUJ, Dayalbagh Agra, India
SARAPUU, ERICH, Kansas City, Mo.
SCHMIDT, GEORGE S., 3rd, York, Pa.
SCHMIDT, KARL E., Grosse Pointe Woods, Mich.
SCHOLTEN, RICHARD A., Valparaiso, Ind.
SEAY, EDWARD R., Kingsport, Tenn.
SMITH, ROGER L., Lakewood, Ohio
SMITHSON, JESSE H., Wilmington, Del.
SODERHOLM, ALVIN C., Chicago, Ill.
SPROULE ROBERT S., Westmount, Que., Can.
SUNDERLAND, R. P., Chicago, Ill.
TANNENBAUM, GERALD, Milwaukee, Wis.
TEUFEL, JOHN, New York, N. Y.
TOKARZ, L. J., Whiting, Ind.
TOMPKINS, BENJAMIN J., JR., Kansas City, Mo.
TRAUTMAN, WILLIAM R., East Aurora, N. Y.
UNRUH, EARL W., Independence, Kan.
VITALE, BENEDICT F., Auburn, N. Y.
WALL, WILLIAM B., Savannah, Ga.
WALLACE, WILLIAM, Gary, Ind.
WEBER, ARTHUR J., Chicago, Ill.
WEBSTER, DEANE C., Greenwich, Conn.
WHITE, L. P., Birmingham, Ala.
WILLIAMS, TREVOR O., East Pittsburgh, Pa.
WRIGHT, MILTON J., Cincinnati, Ohio
YAMAMOTO, MITSURU, Philadelphia, Pa.
YORINKS, ALEXANDER, New Hyde Park, L. I., N. Y.
YOUNG, HOWARD S., Wilmington, Del.

CHANGE IN GRADING

Transfers to Member and Associate

BAHN, GILBERT S., Schenectady, N. Y.
BARTA, GEORGE L., Jr., Little Neck, N. Y.
BLACK, WILLIAM S., Evergreen Park, Ill.
BREYMEIER, R. THOMAS, Niagara Falls, N. Y.
GOODWIN, JOHN H., San Francisco, Calif.
GORDON, ARTHUR, Linden, N. J.
LLANSO, JOAQUIN J., Springfield, N. J.
MALCOLM, DONALD G., Berkeley, Calif.
MCALISTER, ANDERSON O., Wilmington, Del.
MCKAY, GORDON B., Ramsey, N. J.
MILLER, DURBEN E., Monroe, La.
MOEN, WALTER B., Berkeley Heights, N. J.
NASH, WILLIAM A., Washington, D. C.
RISE, KAARE, Wilmington, Del.
WAYNE, HARRY B., Brooklyn, N. Y.
ZIETLOW, FRED P., Indianapolis, Ind.

Transfers From Student Member to Junior 24

Obituaries

Ernest James Abbott (1900–1952)

ERNEST J. ABBOTT, general manager, Micrometrical Manufacturing Co., Ann Arbor, Mich., died at Colorado Springs, Colo., Oct. 6, 1952. Born, Battle Creek, Mich., Sept. 11, 1900. Parents, Albert Sackett and Nona Belle Abbott. Education, BS(EE), University of Michigan, 1924; MS, 1925; PhD, 1932; EE, 1935. Married Marion Elizabeth Rich, 1925; children, Jean P., Shirley A., George E. He did pioneering work on the measuring of surface irregularity and wrote many papers on electronic-measurement applications. Founded Physicists Research Co. for the purpose of developing and manufacturing production-control instruments. Mem. ASME, 1937. He served the Society as a member of the Executive Committee, Detroit Section, and as member at large, ASA—B-46 Committee.

Harold Bedford Atkins (1872–1952)

HAROLD B. ATKINS, consulting engineer, Jacksonville, Fla., died May 10, 1952. Born, Brooklyn, N. Y., Feb. 24, 1872. Parents, Thomas B. and Elizabeth J. (Dunham) Atkins. Education, ME, Stevens Institute of Technology, 1892. Married Winifred Whitney, 1938. Mem. ASME, 1903. Survived by his brother, A. W. Atkins, Jacksonville, Fla.

Robert O. Benecke (1917–1952)

ROBERT O. BENECKE, mechanical engineer, Convair, San Diego, Calif., died Sept. 27, 1952. Born, St. Cloud, Minn., Aug. 5, 1917. Education, BS (ME), Iowa State College, 1941. Mem. ASME, 1949. He served the Society as secretary-treasurer, Nebraska Section, and as vice-chairman and program chairman, San Diego Section. Survived by his wife, Donna V., and his mother, Mrs. Gertrude Benecke.

Albert Franklin Bullock (1913–1952)

ALBERT F. BULLOCK, partner, Bullock and Carroll, Fairfield, Ala., died Sept. 18, 1952. Born, Greenwood, Miss., July 20, 1913. Education, BS (ME), University of Alabama, 1949. Jun. Mem. ASME.

Fred Stuart Carver (1886–1952)

FRED S. CARVER, owner, Fred S. Carver, Inc., Summit, N. J., died Aug. 15, 1952. Born, Lincolnville, Me., Dec. 30, 1886. Education, attended high school. During World War I he laid out and directed installations of equipment for production of large-size copper bands for shells by extrusion process in several plants. With W. H. Harman he was granted a U. S. Patent for this process, by which the greater part of bands used by U. S. and Canadian governments were made. Mem. ASME, 1921.

Samuel Endres Diescher (1873–1952?)

SAMUEL E. DIESCHER, whose death was recently reported to the Society, was a consulting engineer, S. Diescher and Sons, Pittsburgh, Pa. Born, Pittsburgh, Pa., Feb. 19, 1873. Parents, Samuel and Caroline (Endres) Diescher. Education, attended Pittsburgh schools. Married Emily M. Ohlig, 1912. He held about 60 patents relating to seamless tube-making, tin-plate making, and other fields. He was consultant to National Inventors Council. Mem. ASME, 1915.

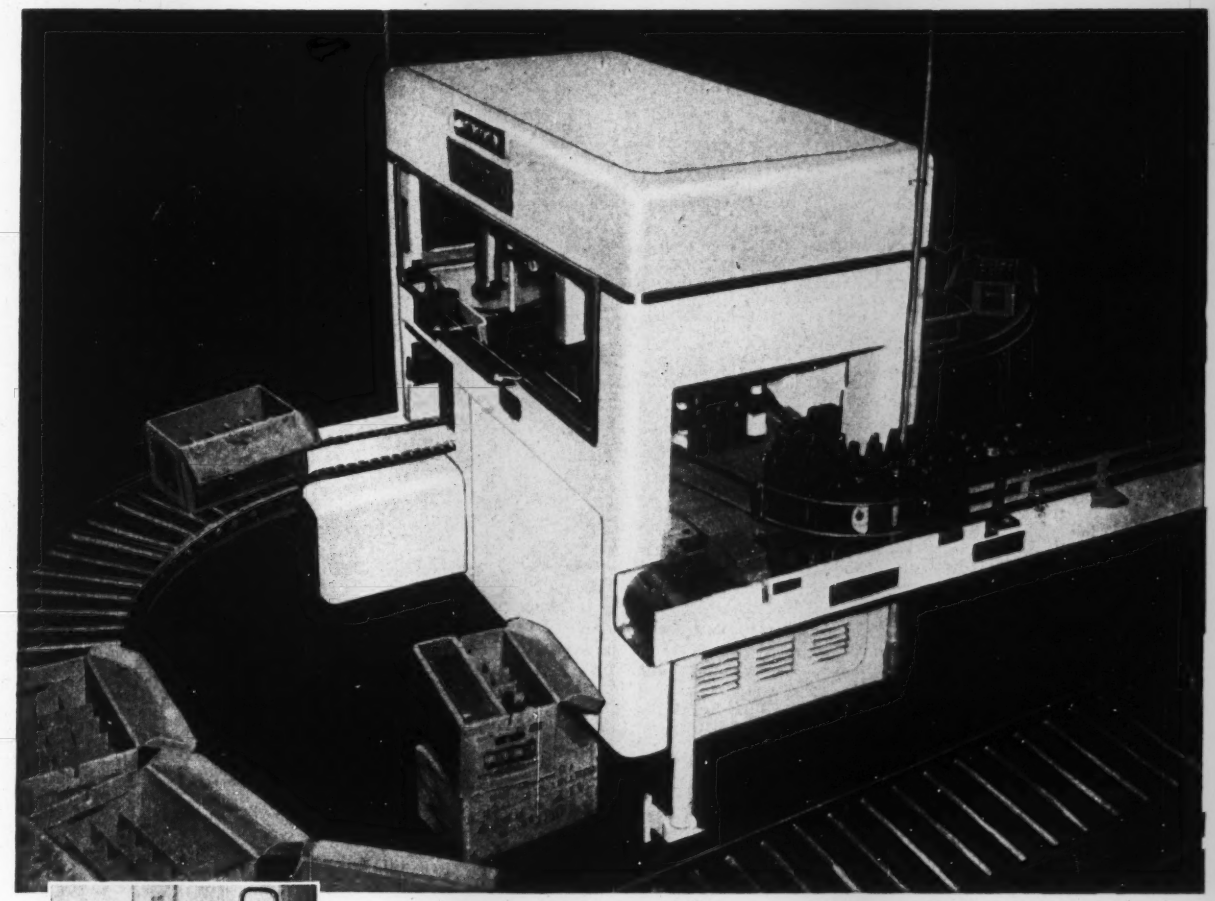
Edward Lucius Dillon (1869–1952)

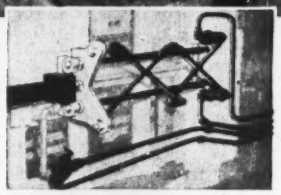
EDWARD L. DILLON, consulting engineer, firm of Edward L. Dillon, House Springs, Mo., died May 25, 1952. Born, St. Louis, Mo., June 22, 1869. Education, graduate, St. Louis Manual Training School, 1886; private tutors. Mem. ASME, 1940.

Edward Flad (1860–1952)

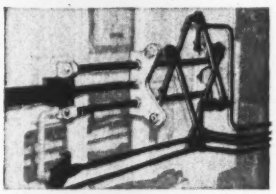
EDWARD FLAD, consulting engineer, St. Louis, Mo., died Oct. 16, 1952. Born, Arcadia, Mo., Nov. 23, 1860. Parents, Henry and Caroline (Reichard) Flad. Education, CE, Washington University, 1881. Married, Emilie E. Speck, 1890 (died 1935); daughter, Virginia S. (Mrs. H. Towner Deane). He was member, Board of Freeholders, City of St. Louis, that drafted a new city charter, adopted in 1914. He engineered the construction of the St. Louis Water Works, 1883–1888. He was water commissioner, City of St. Louis, and member, Board of Public Improvements, 1899–1903. Appointed

(*ASME News continued on page 106*)

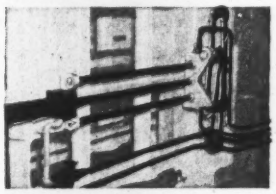




CHIKSAN aircraft hydraulic swivel joints employed in this application permit complete flexibility in contraction and extension of otherwise rigid fluid lines.



CHIKSAN joints allow the Ermold unpacker head to travel backward and forward with the hydraulic lines folding and unfolding automatically.



CHIKSAN aircraft swivel joints enable Ermold to make sharp bends in the hydraulic lines as the mechanism moves forward and backward in the unloading operation illustrated above.

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When the Ermold Division of The Barry-Wehmiller Machinery Company decided to put out an improved automatic unpacker, it just naturally turned to Chiksan Ball-Bearing Swivel Joints to provide the necessary flexibility and stamina for the electrically-controlled hydraulic system.

This system imparts the motion for precision stopping and starting—for raising and lowering elevating mechanism—for gripping firmly and delicately the most fragile material.

This application is just another example of how industry relies on Chiksan's mastery in the flow of liquid and gas--around seemingly impossible joints and angles—and through unyielding metal. Years of engineering of swivel joints have taught Chiksan how to gain precision, achieve incredibly close tolerances, provide higher resistance to extremes of temperature and pressure. *Whether you're a bottler, a chemical processor—engaged in heavy industry, transportation or the petroleum industry, Chiksan Ball-Bearing Swivel Joints can help do a better job for yourself—for your customers—for less. Chiksan's Department of Development and Research stands ready to put its experience and skill to work for you. Write for Catalog 2A, Dept.* ME-1.

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for life to Mississippi River Commission in 1924 by President Calvin Coolidge. He also served as member of U. S. Naval Consulting Board (1916) and on the Public Service Commission of Missouri. Mem. ASME, 1891.

William Alfred Gunning (1882–1952)

WILLIAM A. GUNNING, whose death was recently reported to the Society as having occurred April, 1952, was design engineer, American Optical Co., Southbridge, Mass. Born, Norfolk, Mass., Feb. 18, 1882. Parents, James and Annie E. (Smith) Gunning. Education, Business College, Bryant and Stratton; University Extension, M.I.T.; correspondence schools. Married Viola P. Hodgkins, 1910. Held patents on optical goods and machinery. Mem. ASME, 1936.

Daniel Fowlston Higgins (1923–1952)

DANIEL F. HIGGINS, methods engineer, Standard Handbag Co., Plainfield, N. J., died Aug. 23, 1952. Born, Englewood, N. J., Oct. 14, 1923. Education, ME, Stevens Institute of Technology, 1947. Married Lillian Greenwalt, 1947. Jun. ASME, 1948. Survived by his wife, two daughters, Alice Ruth, Lynn Barbara; his parents, Mr. and Mrs. John Higgins; two brothers, Spencer P. and J. Barry Higgins.

Robert Smith Johnston (1885–1952)

ROBERT S. JOHNSTON, consulting engineer, Yardley, Pa., died Sept. 26, 1952. Born, New York, N. Y., March 15, 1885. Education, BS (CE), Tufts College, 1908. Mem. ASME, 1921. Survived by wife, Jessie Johnston.

George Washington Martin (1876–1951)

GEORGE W. MARTIN, retired, formerly supervising engineer, U. S. Realty Co., New York, N. Y., died Aug. 29, 1951. Born, Brooklyn, N. Y., Aug. 8, 1876. Parents, Henry and Margaret (Moore) Martin. Education, ME, Stevens Institute of Technology, 1899. Married Clara Fowler, 1904 (died 1946); children, Margaret E., Helen L., F. Elizabeth. Married 2nd, Alice Wharton Martin, 1948. Mem. ASME, 1911. He is survived by wife, three daughters, and six grandchildren.

William Campbell McClennan (1912–1952)

WILLIAM C. MCCLENNAN, senior associate, Bruce Payne and Associates, Westport, Conn., died in Cleveland, Ohio, Aug. 1, 1952. Born, Albany, N. Y., Nov. 19, 1912. Education, ME, Cornell University, 1935. Mem. ASME, 1951.

Eric Hugo Nelson (1877–1952)

ERIC H. NELSON, formerly vice-president in charge of manufacturing, The Griscom-Russell Co., Massillon, Ohio, died in August of 1952. Born, Norrkoping, Sweden, Feb. 11, 1877. Education, Norrkoping School of Technology, 3-year course; graduate, Lowell Institute School for Industrial Foremen. Naturalized U. S. citizen. Boston, Mass., 1905. Mem. ASME, 1909.

William Noyes (1896–1952)

WILLIAM NOYES, whose death was recently reported to the Society, was assistant chief designer, Armstrong Cork Co., Lancaster, Pa. Born, Andover, Hants, England, April 8, 1896. Parents, John and Elizabeth (Hewitt) Noyes. Education, British Boys High School; South Kensington School of Design, London, England, 1913. Naturalized U. S. citizen, Lancaster, Pa., 1935. Married Margaret McCartney, 1928, children, John Hewitt, William Robert. Mem. ASME, 1931. Served Society as chairman, Susquehanna Section, 1935–1936, Executive Committee, Susquehanna Section, 1939–1940.

Leonard Robert Nyman (1927–1951)

LEONARD R. NYMAN, jet-engine tester, Allison Division, General Motors, Indianapolis, Ind., died July 12, 1951. Born, St. Paul Minn., Aug. 4, 1927. Parents, Fabian Walter and Ebba Cecilia Nyman. Education, BME, University of Minnesota, 1950. Jun. ASME, 1950. Survived by mother.

Robert Cuttler Pattison (1880–1952)

ROBERT C. PATTISON, retired mechanical engineer, Wheeling and Lake Erie Railway Co., Brewster, Ohio, died in Massillon, Ohio, Sept. 1, 1952. Born, Wytheville, Va., Sept. 8, 1880. Education, BS(ME), Virginia Polytechnic Institute, 1905. Mem. ASME, 1920. Survived by his wife, Charlotte J., and one son, Robert, aviation cadet, USAF.

Mathew Michael Riccio (1921–1952)

MATHEW M. RICCIO, foreman, Sargent and Co., New Haven, Conn., died June 5, 1952. Born, Bridgeport, Conn., June 15, 1921. Education, BS(ME), University of Connecticut, 1949. Jun. Mem. ASME, 1949.

Peter James Soulen (1882–1952)

PETER J. SOULEN, whose death was recently reported to the Society, was a consulting engineer, Milwaukee, Wis. Born, Milwaukee, Wis., June 22, 1882. Parents, Henry and Elizabeth Soulen. Education, attended public schools. Married Alida Kamerling, 1903; children, Johanna, Mildred, Lillian. Mem. ASME, 1935.

Alonzo G. Trumbell (1874–1952)

ALONZO G. TRUMBELL, retired, formerly with Chesapeake and Ohio Railway, Cleveland, Ohio, died May 27, 1952. Born, Hornell, N. Y., March 22, 1874. Education, ME, Cornell University, 1899. Mem. ASME, 1927; Fellow ASME, 1946. He served the Society on the Executive Committee, Railroad Division, 1928–1933.

George Fulton Waddell (1865–1952)

GEORGE F. WADDELL, retired engineer, San Francisco, Calif., died Sept. 30, 1952. Born, Upper Stewiacke, Nova Scotia, Can., May 6, 1865. Parents, Richard Christie and Margaret (Fulton) Waddell. Education, high school and night school. Married Amelia Harriet Madelaine, 1895; children, Madelaine Margaret, Louis Waddell (died 1905). Assoc. ASME, 1895. He served on the Board of Managers, National Industrial Inventory of 1915 for state of Idaho, conducted by the five national engineering societies.

John Culbertson White (1868–1952)

JOHN C. WHITE, steam and mechanical engineer, Madison, Wis., died Sept. 19, 1952. Born, Pana, Ill., July 11, 1868. Parents, Samuel and Amelia (Shafer) White. Education, attended Pana High School; University of Wisconsin Extension School; hon. ME, University of Wisconsin, 1928. Married Sara E. Chuse, 1893 (died 1933); children, Sibyl (died 1922); Bernice (died 1900), Myrna, Helen. Married 2nd, Ambrosia Chuse, 1935. Jun. ASME, 1906. Mem. ASME, 1911.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult reverse side of card for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting your address, business connection, and Professional Divisions enrollment is printed on this page. Please use it to keep the master file up to date.

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(Not for use of student members)

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Title of position held .....

Nature of work done .....

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1 .....

2 .....

3 .....

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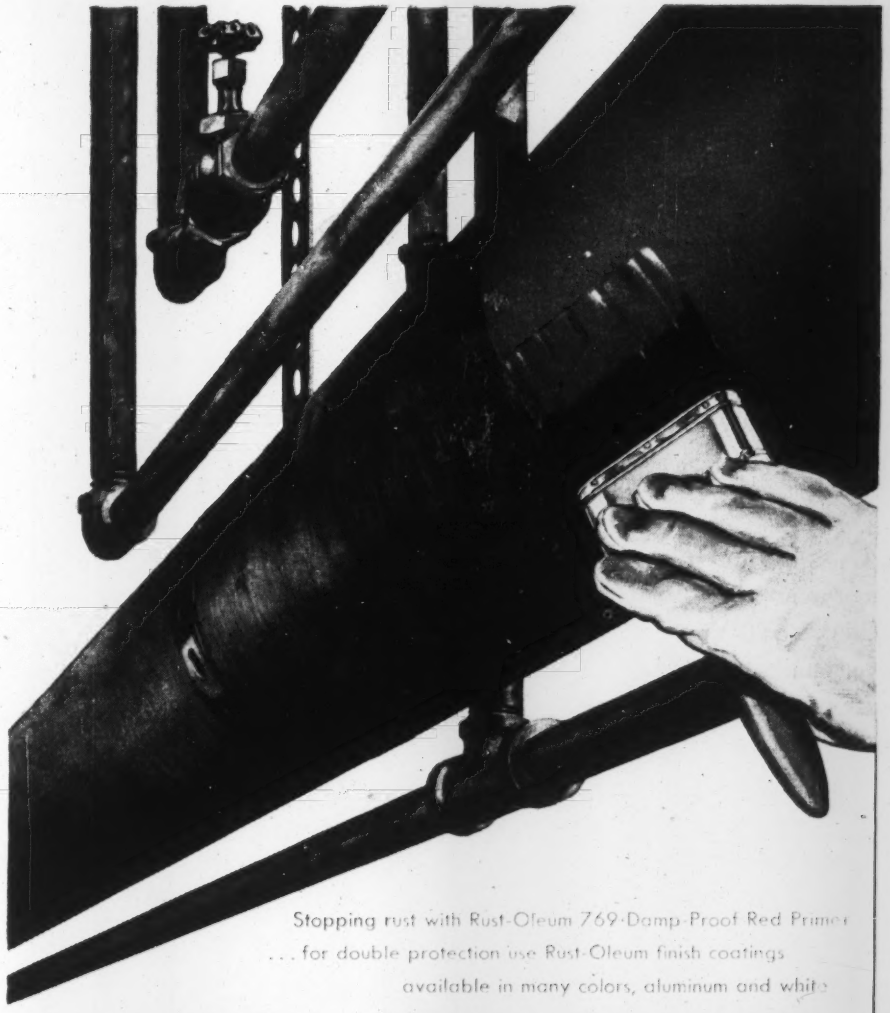
I am a subscriber to (please check)

Transactions ☐ Journal of Applied Mechanics ☐ Applied Mechanics Reviews ☐



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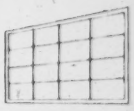

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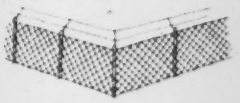

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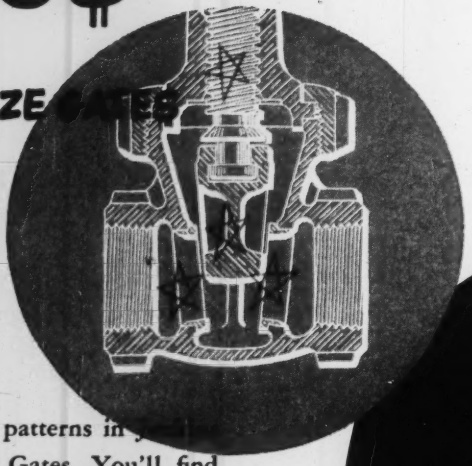
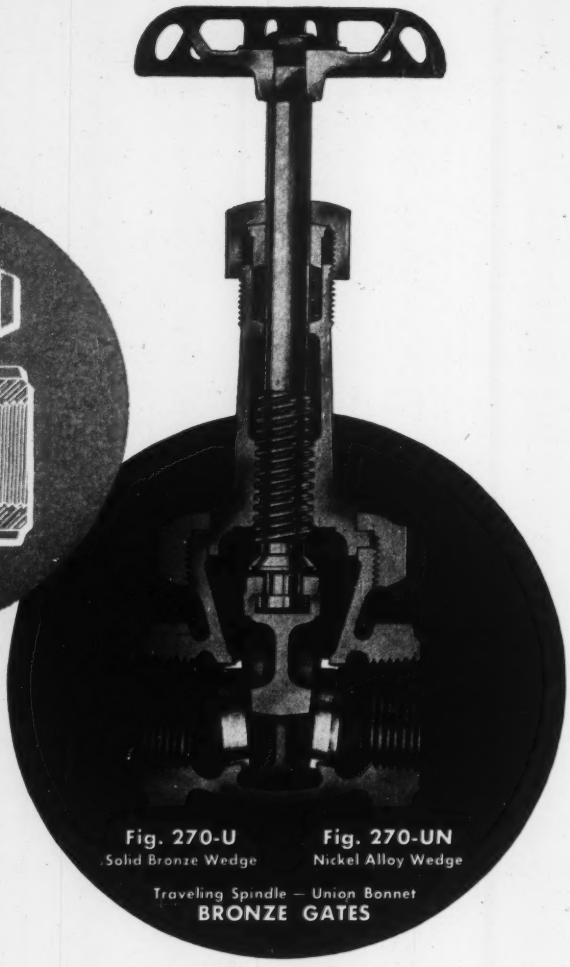
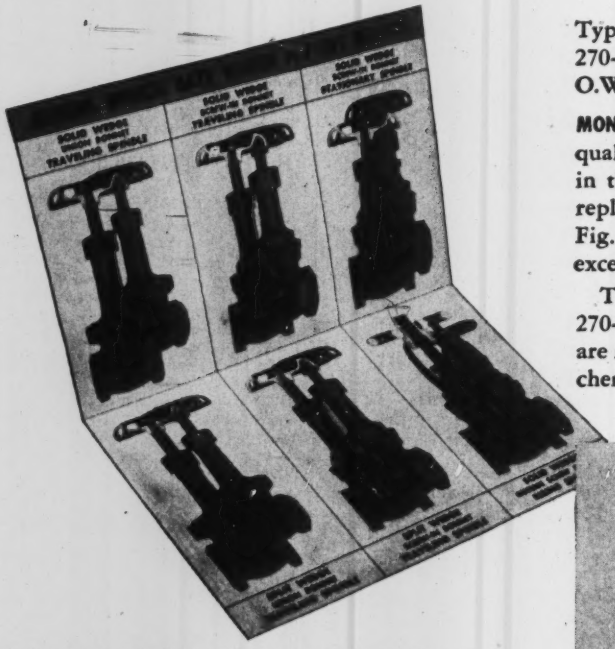




Look over any of the 35 patterns in your complete line of Bronze Gates. You'll find *savings* built into every valve. Jenkins valve specialists designed each one for easy maintenance and extra long wear. Try them on your toughest services and see why they take top-rating in any test for endurance and economy. Jenkins Bros., 100 Park Ave., New York 17.



Jenkins Bronze Gate folder shows the many types available — lists convincing reasons why they are your best buy for any service. Ask for Form 181-A.

Typical of Jenkins design for built-in savings are the Fig. 270-U and Fig. 270-UN Gates for 200 lb. Steam, 400 lb. O.W.G. services.

MONEL AND BRONZE SEATING COMBINATION In Fig. 270-U a high quality bronze wedge seats against MONEL rings expanded in the body. The wedge takes the wear — it can easily be replaced when necessary by slipping a new one on the stem. Fig. 270-UN, with a nickel alloy wedge, is recommended for exceptionally severe conditions of rapid wear and corrosion.

These and other features of rugged construction make Figs. 270-U and 270-UN first choice for economy where conditions are most destructive to valves, as in oil refineries, dye houses, chemical, food, and rubber plants.

JENKINS VALVES

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ANNOUNCEMENTS OBTAINED MOSTLY FROM ADVERTISERS IN MECHANICAL ENGINEERING AND ASME MECHANICAL CATALOG

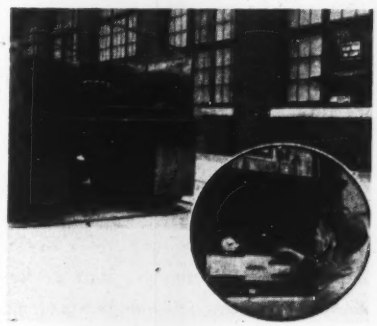
New Equipment *Business Notes* *Latest Catalogs*

Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

New Equipment

Load Cell

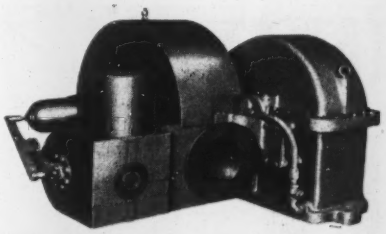
A large Chicago steel company, utilizing modern techniques in proper load distribution for their heavy trucks, ran into a difficult installation problem right at their front door. A mechanical lever-type scale was being constructed in the street when a huge conduit, buried years ago by a power company, was found under the sidewalk. The cable was positioned directly on a level with the scale transverse lever which was to extend to the recorder inside the building. To move the cable was impracticable from the standpoint of time and money necessary. And the mechanical scale could not be temporarily discarded because of the substantial investment put into it, and also the immediate need for an operating scale. Streeter-Amet Co. engineers were consulted to help find a solution.



A basic component of an S-A electronic scale, the Baldwin SR-4 Load Cell, was installed—in conjunction with the electronic recorder—to eliminate use of the extended transverse lever, and thus overcome the problem of moving the power cables. The load cell functions under the principal that electrical resistance of the strain gage inside the cell changes as stress is applied. The electronic recorder measures and prints the exact change in voltage which corresponds to the weight on the scale. In this instance, the load cell operates with a mechanical scale, and reacts to tension. (A completely electronic installation usually requires four load cells and reacts to compression.) A direct cable connection was then made from the load cell to the electronic recorder (shown in window) to accurately register the weight distribution. A brochure explaining the Ametron Electronic Scale is available from Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.

High-Speed Reduction Gears

Elliott Co., Jeannette, Pa., announces a new line of high-speed reduction gears for mechanical drive turbines. The new gears are available in built-in or coupled designs. Built-in gears include Elliott turbine and gear case firmly secured together, with turbine wheels and pinion mounted on the same sturdy high-speed shaft. This eliminates exhaust-end bearing and coupling, permitting a compact unit of minimum over-all length. The coupled design is a self-contained gear unit which is flexibly coupled to a separate turbine drive.



Both designs feature precision-hobbed double-helical gears, liner-type sleeve bearings, special Kingsbury-type shaft seals, and self-contained forced-free lubrication system. The new line of gears is offered in gear ratios up to 5:1 for built-in units; up to 8.5:1 for the coupled design.

Further design details, as well as weights and essential dimensions, are included in a new bulletin, H-19, available through Elliott Co.

Load-Testing Resistor

A new standardized loading resistor for load-testing the power plants of Diesel-electric locomotives rated up to 2500 hp is available from the Westinghouse Electric Corp.

This loading resistor, type TT-148, is a completely self-contained, compact unit that consists of 12 resistor trays, a motor-driven blower, knife switches, and measuring instruments. It is 42 in. wide, 46 3/4 in. deep, 104 3/8 in. high, and weighs 3500 lb.

The resistor sections are connected through knife switches and bus bars that make possible ten different series-parallel combinations to give ten load points. Resistor elements are mounted to provide maximum surface cooling and have slip-joint supports to allow expansion under load. Individual resistors can be replaced without disturbing adjacent elements.

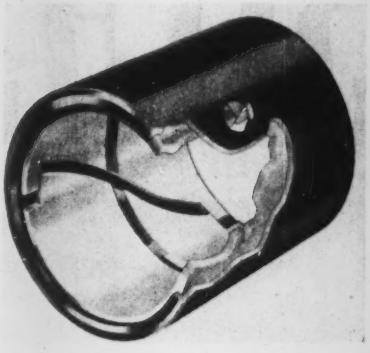
The blower motor, which is mounted vertically at the base of the structure, is part of the resistor circuit, so no external source of power is required.

For further information, write Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Nylined Bearings

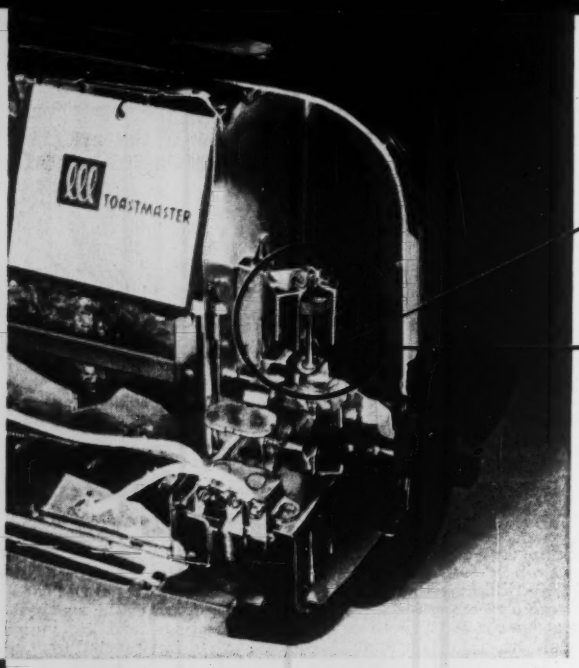
A new type of nylon-lined bearing has been developed by Thomson Industries, Inc., Manhasset, N. Y. These bearings consist of a thin drawn-steel outer sleeve and a free floating liner of DuPont FM 10001 nylon. They are called standard thinwall Nylined bearings, and are initially being offered in 10 sizes ranging from 1/4 to 1 1/4 in. ID.

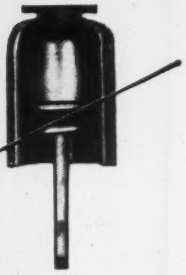
DuPont nylon is widely recognized for its excellent bearing characteristics, but ordinary molded or machined nylon bearings have limitations due to the clearances required to allow for expansion due to temperature and moisture absorption, as well as distortion due to internal stresses. Also plain nylon bearings cannot be press-fitted, and they usually use more nylon for structural reasons than is necessary for a bearing surface.



The thinwall Nylined bearings were developed to offer a low-cost solution to these problems and to provide bearings of resilient material which resist poundout, decrease friction, permit dry operation, damp mechanical vibration, and minimize abrasion failures. They are corrosion-resistant and can be operated submerged in most liquids. These extremely compact, lightweight bearings are suitable for close fits and will give a longer life with less maintenance in most applications.

The nylon liner, which is an instantly replaceable bearing surface, is provided with a spiral compensation gap which serves a dual purpose. It compensates for dimensional changes in the circumference due to expansion and contraction which would otherwise cause fluctuations in the bore diameter. In applications where lubrication is required, this gap also serves to distribute lubricant in an axial direction as it connects with the center circumferential lubrication slot which receives lubricant through the hole in the outer sleeve.





Restrictions on brass forced engineers in the Toastmaster Products Division of McGraw Electric Company to find substitute materials for a pneumatic damping device on the toast ejector mechanism. They had been using a cylinder, machined from solid ¾ inch brass rod, and a precision ground brass piston with a connecting rod on a swivel joint. The cylinder head was fitted with a spring and ball check valve. Tolerances on this complicated assembly had to be held within 2 mils to give satisfactory performance for at least 100,000 cycles at 350° F.

On pneumatic dampers

SILASTIC* simplifies design

...saves critical materials

Many substitute materials and designs were tried with disappointing results before one of our technical representatives dropped in with samples of Silastic. Using this heat-stable, rubbery silicone product, Toastmaster's research and development engineers perfected a very simple and durable damper. It consists of an inexpensive drawn steel cylinder, a 1-piece connecting rod, and a flat ring-shaped Silastic piston mounted loosely between two metal cup washers with a simple air leak past the shoulder of the piston.

Tolerances on the new damper are large; the cylinder can be out of round; 86 pounds of mild steel displace 199 pounds of brass per 1000 toasters. *And the new device works better than the more expensive brass assembly.* Such performance proves the usefulness of Silastic as a new engineering material. It retains its rubbery properties and its good dielectric properties at temperatures ranging from below —70 to above 500° F. It is highly water repellent; shows excellent resistance to weathering and to a variety of hot oils and chemicals.

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Welding and Forming Machine

A combination forming and welding machine has been developed jointly by Struthers Wells Corp. and the Federal Machine and Welder Co. Machines are presently being produced to form and weld a wide range of appliance cabinets and liners. The combination machine consists of a Struthers Wells quadruplex tangent bender with a Federal welding component mounted on a beam which is raised and lowered with each machine sequence to make the forming operation possible.

The material is first placed in the lower dies of the bending machine and then the operator presses a button to start the fully automatic forming and welding cycle. The bender forms the cabinet to the desired shape and the last bender operation actuates a limit switch which initiates the automatic welder cycle. At this point, the welder beam is lowered and automatically latched to the male bender die. The welding guns then engage the cabinet and make the welds. The guns retract, the beam unlatches and raises to dwell position. At the time the welding beam starts to retract the bending wings of the tangent bender also return to their initial position. The cabinet assembly is then automatically lifted to a position where it will easily clear the male die for unloading.

Production costs are materially reduced by an installation of this type compared with conventional methods of forming in a bender and then transferring to a separate weld station. Only one operator is required to perform both operations in this single combination machine.

The combining of the welding and bending machine also saves valuable floor space. Not only is the floor space occupied by the welding machine saved, but also, the large area required to store unwelded assemblies is also saved. This amounts to considerable plant area, particularly in the manufacture of freezer, washer, and dryer cabinets, liners, etc.

Since the weld is made while held to size in the bender there is no need for over-forming, which also eliminates sizing fixtures.

The welding component shown in the photograph is designed with a series welding circuit, the series die being incorporated in the male die of the bender. For heavy gages, direct welding is used. Units have been designed where the welding guns index, and in this way, the spacing on any series circuit can be enlarged to give the most ideal welding conditions.

The Federal welder unit features the latest developments in welding machine design, incorporating package transformers wherever possible.

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New Catalog Shows How

"DIE-LESS DUPLICATING" SAVES TOOLING COSTS, SPEEDS PRODUCTION

Shows many photos of "Die-Less Duplicating" forming technique with Di-Acro Machines. Features 36 hand and power models in quick reference tables. Explains free Di-Acro Engineering Service. Write for your copy now.

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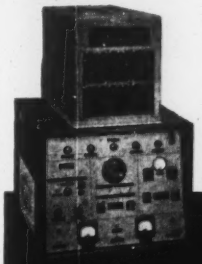

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HATHAWAY Type SC-16 OSCILLOGRAPH

The NEW and PHENOMENAL Hathaway Type SC-16 Oscillograph with 6 elements is *flat from 0 to 200,000 cycles per second*, and its traces have a writing speed of *5 million inches per second.*

Fast transients and high-frequency phenomena can be accurately recorded.

Several types of continuous-drive record magazines are available for 6-inch sensitized paper and film, and for 35-mm film. Drum-type magazines, both small and large, are valuable for short high-speed records. 10-foot drum-type charts can be driven at 3000 RPM for a chart speed of 6000 inches per second when high resolution is needed.

Useful for strain recording to 100 Kilocycles.

Automatic Operation Initiate a transient with the oscillograph, or let the transient start the oscillograph.
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***If you want*—Readings of AVERAGE RPM or FPM...**

—choose one of the several ranges available in **Jagabi® Chronometric Speed Indicators** from 0-100 up to 0-100,000 rpm. The shaft or spindle is set in ball bearings. No lubrication needed. Design and construction of these instruments is such that a minimum of maintenance is required even in constant, severe service.

The **Jagabi Tachoscope,** stop watch and revolution counter, is also recommended for high accuracy work. **BULLETIN 35-ME.**

***If you want*—Readings of INSTANTANEOUS SPEEDS or VARIATIONS in SPEEDS**

... select the **Jagabi® Centrifugal Tachometer**—speed ranges 25 to 48,000 rpm. Three—and five—ranges in one instrument . . . or the **Dr. Horn Tachometers** which are made with 6 ranges between 25 and 30,000 rpm. Both Jagabi and Dr. Horn Tachometers have a special friction coupling which minimizes the damaging effects of too fast acceleration and over-speeding. Results: Low maintenance and long, dependable service life, for direct indicating, rpm shaft or fpm linear and peripheral speeds and speed variations. **BULLETIN 35-M.**

B-812

If you want*—QUICK and ACCURATE RPM READINGS with *SAFETY

... Consider the advantages of **Frahm® Resonant Reed Tachometers** for hand use or permanent mounting.

No contact with moving parts is required. Just touch the instrument to the chassis, frame or housing of the machine or motor and read the rpm directly. No moving parts. No lubrication or maintenance required. Accurate to ½ of 1%, they will operate continuously for years without any appreciable change. Instruments with limited ranges available for as little as $27. Practically any desired range within 900 and 100,000 rpm can be supplied. **BULLETIN 41-M.**

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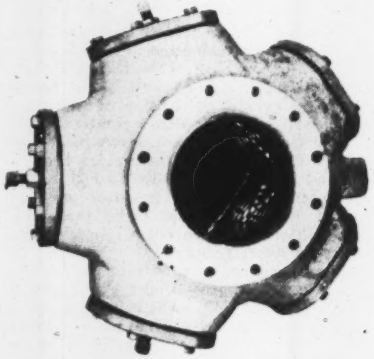
12-In. Aircheck Valve

Illustration below of a 12-in. Aircheck valve reveals the inlet flange and gives a peep at the valve assemblies themselves inside.

Four of these 12-in. Aircheck valves have been installed at the U.S. Smelting Mining & Refining Co. and will handle the discharge from four compressors, each having a capacity of 4500 cfm free air.



From the illustration it will be noted that each and every individual valve assembly is accessible immediately without disconnecting any piping.

Made by Pennsylvania Pump and Compressor Co., Easton, Pa., Aircheck is the only automatic compressor discharge line check valve which dampens pulsations.

Electric Heater

A new heavy-duty electric heater has been designed to preheat large studs that are used to clamp large castings together on heavy equipment, such as hydraulic presses. Quick heat is provided at the assembly point with the portable electric heating unit.

In order to tighten the nuts securely, the studs must be lengthened temporarily. This is done by drilling a hole through the stud and inserting the stud heater in this hole. The stud expands lengthwise, allowing the nuts to be tightened more than would be possible if the stud were cold. When the heater is withdrawn and the stud cools, a very tight fit results—in the same manner that rivets tightly join structural steel members.

The stud heater consists of alloy-sheathed Chromalox electric tubular units fitted in a gun-shaped stainless-steel holder. The handle grip aids extraction of the heater. Various sizes and ratings are available to accommodate studs of different sizes. Standard lengths range from 10 to 70 in.; capacities from 2 to 12 kw; and outside diameters from about ½ to 1 in.

For more information write to Edwin L. Wiegand Co., 7646 Thomas Blvd., Pittsburgh 8, Pa.

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NEW EQUIPMENT
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25-KW R-F Generator

A new 25-kw radio-frequency generator (standard and de luxe) is available from Westinghouse Electric Corp. The standard model is for use on relatively long production runs where readjustment of the r-f generator will be infrequent; taps on the plate transformer provide power output control. The de luxe model uses saturable reactors to provide especially reliable stepless power control, which facilitates make quick set-up changes as required on short production runs of a variety of jobs. An electronic keying circuit is also included on the de luxe model to permit rapid and precise control of heat cycles.

The unit is rated at 25 kw continuous at 450 kc in accordance with NEMA standards. The tank circuit has a high kva rating, which is the real measure of performance of useful work that can be accomplished.

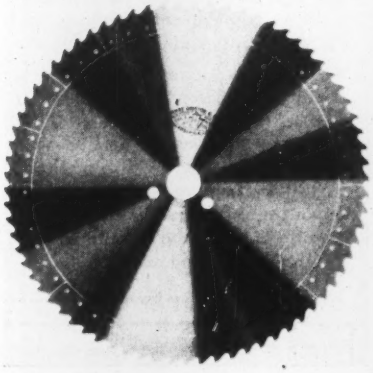
Both models have the components arranged for easy access for inspection and maintenance. Filament voltage is controlled to ±3 per cent to prolong tube life. The unit features a built-in closed-circuit water-cooling system, using distilled water, with a water-to-water heat exchanger. Complete protection is provided against condensation and water impurities with minimum raw water consumption.

For further information, write Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Metal-Cutting Saw

A new segmental circular metal-cutting saw claimed to have up to 30% more productive life than any other segmental saw on the market has been announced by Henry Disston & Sons, Inc., Philadelphia, Pa.

Called the Disston Chromos, the new saw features segments which are locked together by flexible tightening pins instead of rivets. This patented design, exclusive with Disston, insures perfect alignment of the segments



around the entire cutting edge, and gives longer life to the saw because there are no aligning rivets to limit sharpening. It also makes possible quick replacement and automatic alignment of segments.

Disston Chromos segmental saws are available in diameters from 11 to 63 in. and with various tooth spacings for cutting any ferrous or nonferrous metals. Center holes are custom drilled on order for perfect fit.

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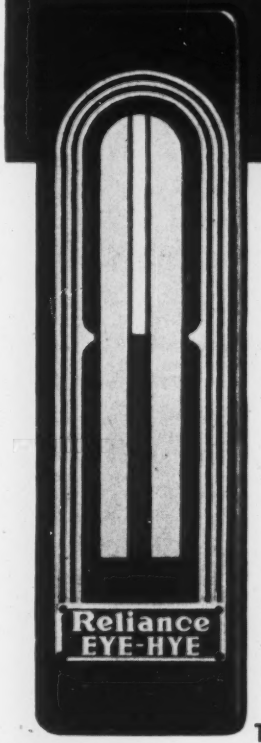

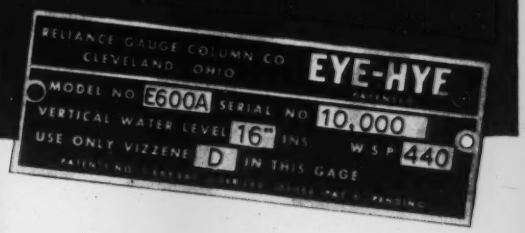
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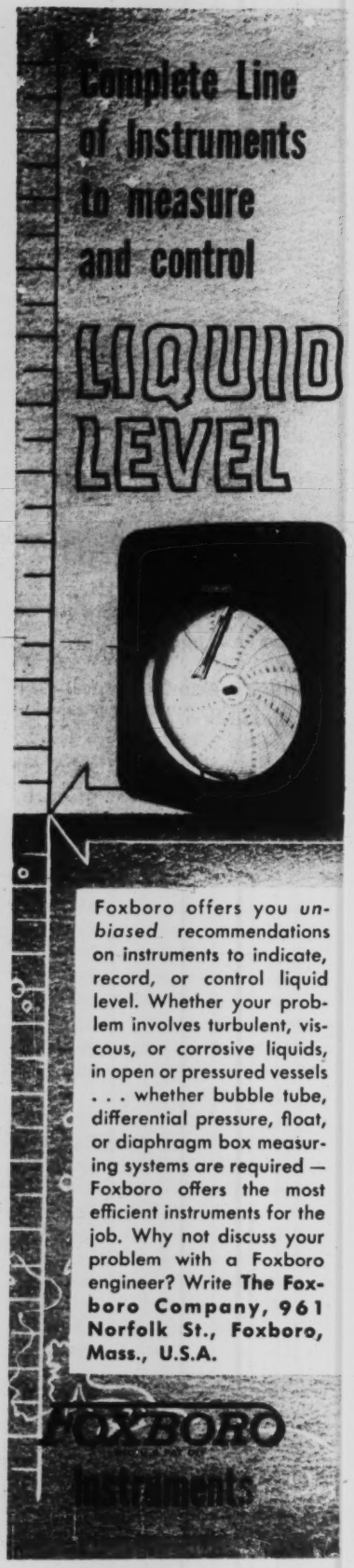
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Instruments

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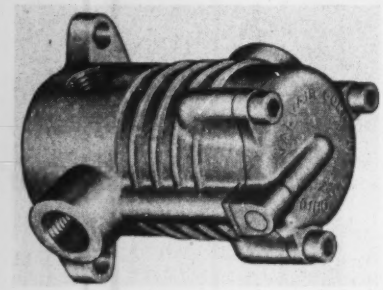
Solenoid Pilot Valve

A new solenoid pilot valve is now offered by Valvair Corp., 1009 Beardsley Ave., Akron 11, Ohio. The valve measures 3 in. in height. The valve handles air, vacuum, oil, water, and inert gases. The body and cover are of high tensile zinc base alloy. The standard coil is adaptable to either continuous or intermittent service. The coil is completely sealed from but is cooled by the fluid or air passing through the valve. There are



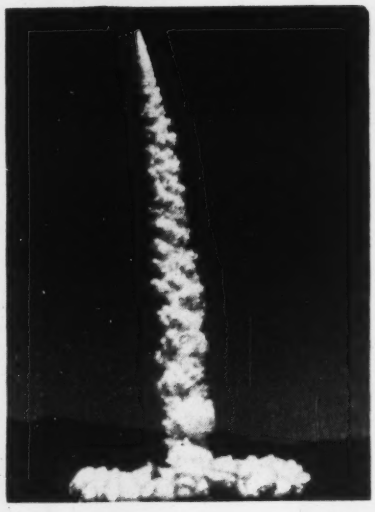
only two moving parts—plunger and stem. The stem is one-piece and unbreakable. Sealing is by Hycar O-rings which will deteriorate from age only. The valve can be drilled through the bottom for manifold mounting to order or can be furnished by Valvair's design. Models include 2-way and 3-way either normally open or normally closed. The following orifice sizes are available: $^1/_{16}$, $^3/_{32}$, and $^1/_8$ in. with $^1/_4$-in. pipe tap.

Torque Converter

A new direct drive hydraulic torque converter for extra heavy-duty trucks has been developed by Twin Disc Clutch Co., Rockford, Ill. Designed especially for trucks carrying loads up to 30 tons, the converter eliminates 99% of forward shifting in off-highway operation. The assembly is completely oil actuated and special hot oil-resistant seals made of Hycar American rubber are used throughout.

Field tests of the Twin Disc unit indicate that a loaded truck can take almost all grades in one gear, saving considerable hauling time in declutching, shifting gears, and clutching. After the mechanical gear ratio has been set, the truck engine picks up speed when accelerated while the converter multiplies the torque delivered as much as five times. Snap shifting is eliminated and trucks pull away in the gear they will use up the entire grade.

The hydraulic clutch actuating pistons and oil pressure supply tubes in the unit are sealed with a total of 16 Hycar 4021 (polyacrylic) rubber "O" rings ranging in size from $^3/_8$ in. ID to 15 $^1/_2$ in. ID. Other specially molded gaskets and garter spring seals in the unit are also made from Hycar 4021, a product of B. F. Goodrich Chemical Co. This new rubber was developed for applications requiring exceptional resistance to oils, extreme pressure lubricants, and high temperatures. It has even greater resistance to these conditions than regular Hycar OR (oil-resisting) rubbers which are commonly used in oil well parts, petroleum hose, automotive seals and gaskets. Like OR rubbers, Hycar 4021 will not change volume in hydraulic oil or distort or cold flow when compressed.



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BOEING

A major guided missile program is just one of Boeing's many projects-with-a-future. Other programs, which offer *you* plenty of room to get ahead in engineering, are America's first announced jet transport project, research in supersonic flight and nuclear-powered aircraft, and development of the B-47 and B-52 jet bombers, the airplanes that have given Boeing more experience with multi-engine jets than any other company.

Boeing offers attractive careers of almost limitless range to men in virtually ALL branches of engineering, for aircraft **DESIGN, DEVELOPMENT, PRODUCTION, RESEARCH and TOOLING;** and for servo-mechanism and electronics designers and analysts, and for physicists and mathematicians.

Boeing pays you a moving and travel allowance. You can work in Seattle, or Wichita. Besides skiing and mountain sports near Seattle, both cities provide fine fishing, hunting, golf, boating — and plenty of opportunity for specialized advanced training. You'll be proud to say, "I'm a *Boeing* engineer!"

Write today to address below or use coupon

JOHN C. SANDERS, Staff Engineer—Personnel
DEPT. M-1
Boeing Airplane Company, Seattle 14, Wash.
Engineering opportunities at Boeing interest me. Please send me further information.

Name _____

Address _____

City and State _____

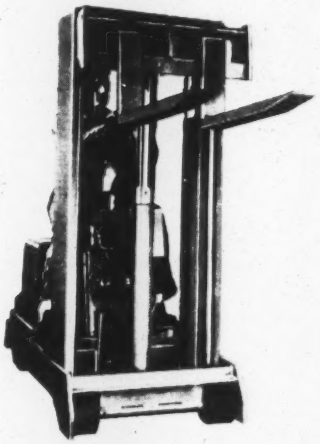
The oil actuated clutch with a hydraulic pump together with a 4-position control valve assembly are responsible for the versatile performance of the converter. Positions of the control valve include neutral, torque, converter drive, direct mechanical drive, and hydraulic braking. Absolute oil-seals are required for perfect operation of each position and Hycar it is said, meets the requirements.

Nontelescopic Fork Truck

The Market Forge Co. of Everett, Mass., has announced the development of a new nontelescopic fork truck to answer the needs of small and medium-sized plants that require faster speed, more power, and a maximum lifting height of 56 in.

The model combines two new features with the specifications of the Marforge 3/4-hp Load-Mobile truck. It retains the interchangeable-power-unit feature of the Load-Mobile line. New are the 1-hp motor and non-telescopic lift.

The truck has been engineered to have the qualities necessary for proper materials handling. Operation is simplified by the use of one foot pedal to control both high and low speeds in forward and reverse. Stabilizing spring-mounted casters prevent swaying on high-speed turns. The 10 1/2-in-diam × 7-in-face drive wheel is designed for easy rolling and high traction. Sharp turning is assured by the high gear reduction steering unit and simple three wheel turning gear.



No-load climbing power is approximately 10 deg—with full load 5 deg. Maximum speeds with the 1-hp are up 25% to approximately 4 1/2 mph with no load, 3 3/4 mph with full load. Exclusive Market Forge protection devices including "dead man" brakes and sealed ball-bearings reduce accidents and machine breakdowns.

The non-telescopic mast has a forward tilt of 5 deg—backward 10 deg. Raising, lowering, and tilting is by means of levers operating hydraulic valves. Lifting speed is 30 fpm, lowering speed a maximum of 60 fpm. This new power model has a load capacity of 2000 lb at 15 in. from the face of the fork, and other load centers are available. Counterbalance is obtained without extra weights through strategic placing of battery, motor, mast, and driver.

Increase output—operate your machines at the best speeds
turn a handwheel
or touch a button
REEVES
Vari-Speed
Motodrive
REEVES
Variable Speed
Transmission
Provides stepless speed adjustability over a wide range—as high as 16 to 1; sizes to 87 hp. Vertical or horizontal designs—open or enclosed.
REEVES
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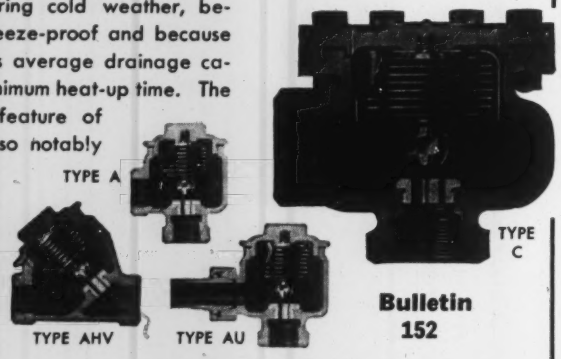
Motor Pulley
Converts any standard, constant-speed motor to a variable speed drive. Speed variations up to 4 to 1. Sizes to 10 hp.
Applied to your machines, REEVES Variable Speed Drives will deliver the exact speed needed for each operation . . . each operator . . . under every changing condition. Speed adjustment is positive and accurate within the fraction of an rpm . . . is obtained instantly, without stopping the machine. Automatic control also available. REEVES is now standard equipment on 2,615 makes of machines. Easily applied to machines in service. Write for complete information to Dept. ME10.
REEVES PULLEY COMPANY • COLUMBUS, INDIANA
Recognized leader in the specialized field of variable speed control

NICHOLSON MAKES

Freeze-Proof Steam Traps

for every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Types for every plant use. Size ¼" to 2"; pressures to 250 lbs.



Bulletin 152

219 OREGON ST., WILKES-BARRE, PA.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

• "Unit Pilot Valve" easily removable — and renewable.

• Stainless Steel parts for lower maintenance, longer wear.

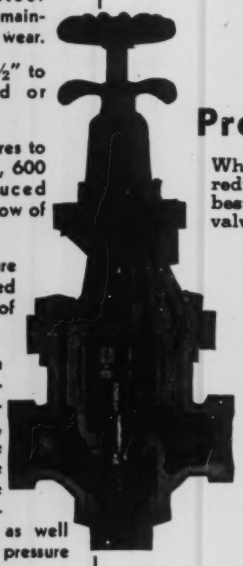
• Sizes from ½" to 6" — Screwed or flanged.

• Initial pressures to 300 lbs. steam, 600 lbs. air. Reduced pressures to a low of 1 lb.

• Varied pressure control obtained without change of springs.

• Available in various combinations for pressure control, temperature control, single unit pressure and temperature regulation as well as constant pressure pump governors.

• Completely interchangeable parts for comparable sizes.



Control reduced pressures more accurately!

KECKLEY

Pressure Regulators

Where you have to maintain ACCURATE reduced pressures for air or steam, your best bet is a precision pressure regulating valve from Keckley. These valves feature a highly sensitive diarhragm and spring design that gives dependable automatic compensation for fluctuating initial pressures, for constant reduced pressures that you can depend on. Standard stainless steel unit pilot valve, main valve and seat can be removed easily for inspection. Here is a valve that is rugged, dependable and unbelievably economical to maintain.

Standardize on Keckley for the best in pressure regulators.

Send for your copy of this catalog—51-O

O. C. KECKLEY COMPANY

400 W. Madison St. • Chicago 6, Ill.

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NEW EQUIPMENT
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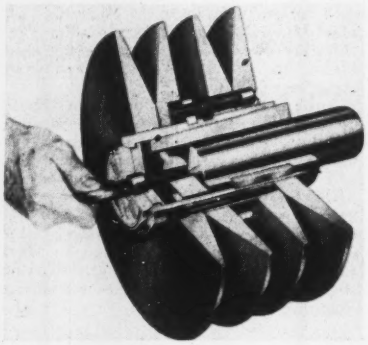
Variable-Speed Drive

A new variable-speed drive incorporating the Taper-Lock principle has been announced by Dodge Mfg. Corp., Mishawaka, Ind. Engineering features in the four units which comprise the new drive cut downtime on speed changes and increase production, according to the manufacturer.

Components of this new Dodge Variable Speed Drive are: (1) a variable pitch motor sheave, illustrated; (2) a set of wide range belts; (3) a companion sheave; (4) a slide motor base. The Dodge Taper-Lock principle is used in the bushings for both sheaves in the new drive and contributes greatly to the rapidity and ease with which speed changes can be made. The drive is exceedingly compact; the sheaves occupy a minimum space on the shaft.



The variable sheave assembly locks on the motor shaft as a unit with the turn of a screw.

The pitch diameter is changed easily and positively by means of a one-point adjustment. The single adjusting screw may be located at either end of the sheave although normally the sheave is factory assembled with the adjusting point located on the motor side. The pitch diameter can be set accurately and cylinder speeds held to extremely close limits.

Vane Type Hydraulic Motors

A new line of oil hydraulic vane motors which provide maximum efficiency and economy is announced by Vickers Inc. Of exceptionally rugged construction and utilizing heat-treated alloy steel for shaft, rotor, and vanes, the motors are built to handle the most difficult service conditions.

Design features also provide for exceptionally long life at continuing high efficiency and low maintenance cost. An exclusive "rocking beam" construction keeps all vanes in intimate contact with the cam ring at all times, yet is not subject to the fatigue failure difficulties of spring-type vane actuators. A combination of low inertia of moving parts and automatic wear compensation for both radial and axial clearance results in exceptionally high performance efficiency throughout the life of the motor.

These motors are unusually compact and of lightweight. Mounting adaptability is provided by a choice of four combinations of inlet and outlet port positions, and choice of flange or foot mounting and either direct, belt, chain, or gear drive.

Vickers vane type hydraulic motors are available in two series, M2-200 and M2-500, for 5.0, 6.5, and 26 hp output. Intermediate sizes are being developed.

Keep Informed

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RotoStoker

A successful demonstration of smokeless operation on light loads of the new RotoStoker was completed recently at Motor Products Corp., Detroit, Mich. A 40,000-lb-capacity steam generator recently equipped with this new Detroit RotoStoker operated at light loads and full capacity without smoke.

The results were gratifying because the plant is located on a main thoroughfare and within a quarter of a mile of a large residential area, being particularly vulnerable to complaint if smoke should occur. The new stoker is a product of Detroit Stoker Co., General Motors Bldg., Detroit, Mich.

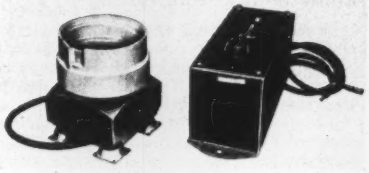
The continuous cleaning feature of this relatively small spreader stoker is secured by a reciprocating grate, the alternate sections of which are fixed. Proper agitation of the fuel bed is provided keeping it porous and at the same time avoiding any blowholes or dead spots. Ample furnace turbulence is provided by a scientifically designed combination over-fire air and cinder return system.

This new stoker offers to spreader-stoker users the well-known "continuous cleaning" benefits for small and medium-sized units from approximately 100 rated boiler horsepower to 75,000 lb of steam per hr. Even more important the manufacturers claim smokeless operation on light loads for small spreader stokers, heretofore difficult when intermittently cleaned.

Parts Feeders

Syntron Co., 498 Lexington Ave., Homer City, Pa., has increased the range of its line of "Vertical Vibratory" parts feeders by adding a new, small model, the EB-00, with its separate controller.

Syntron Parts Feeders are designed to handle various sized and shaped pieces and parts, aligning and positioning them as desired and dispensing them one at a time to packaging, machining, assembling, and other processes.



The addition to the line of this new, small Model EB-00 furnished complete with cast aluminum or sheet steel bowl and separate controller lowers the minimum part length and diameter that can be handled from $1\frac{1}{4} \times \frac{1}{4}$ in. diam to $\frac{1}{2} \times \frac{1}{16}$ in. diam, greatly enlarging the number of parts that can be handled. Its small size base (5 in. sq. $\times$ 7 in. over-all height, including bowl) also permits its adaptability as an integral part of complete processing devices. Literature is available from the manufacturer.

For Consulting Engineers

Turn to Page 120

Making a one-ton load ...a one-man job on Westinghouse Switchgear

WINSMITH SPEED REDUCERS®

Even though it weighs a ton, when the oil circuit breaker on Westinghouse "Unitized" Heavy Duty Switchgear is removed periodically for inspection, it's only a one-man job. A power-elevating mechanism lowers the breaker onto a hand truck and lifts it back to operating position in about 3 minutes.

Heart of the elevating device is a motor-driven Winsmith Helical Gear Speed Reducer, with an input of ¾ hp at 1725 rpm and a reduction ratio of 9.5 to 1, which operates 4 shaft-connected screw-lifts via a drive chain. Like all components of 100% standardized Westinghouse Switchgear, the Winsmith reducer is itself a product of complete standardization.

Whether your power transmission requirements are intermittent like this switchgear, or continuous . . . heavy duty or light . . . Winsmith is the *only* name in speed reducers you need remember. Standardized worm, helical and patented differential gear units are available to serve your specific needs throughout the 1/100 to 85 hp range, in ratios from 1.1:1 to 50,000:1. *Request Catalog 148 for details.*

WINSMITH, INC.
333 June Street
SPRINGVILLE (Erie County), N. Y.

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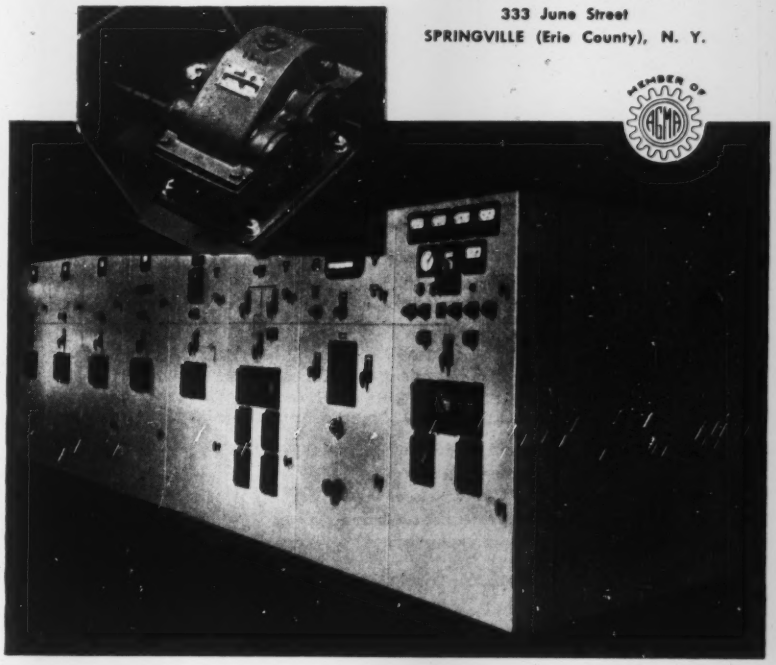

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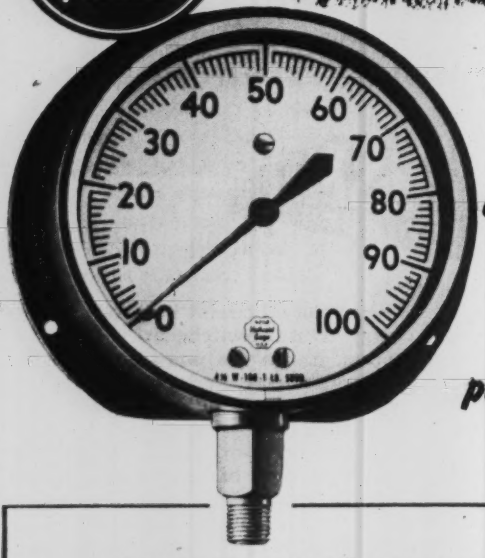
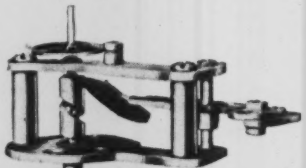


The gage that retains its original accuracy longer, lasts longer, costs less per gage, per year

• Only HELICOID GAGES have the Helicoid Movement . . . tested and proved in years of hard service . . . a simple cam and roller design that does not have any teeth to wear out. Helicoid Gages cost less in the long run because they give long, trouble-free service with a minimum of maintenance.

Helicoid Gages can be furnished with ACALOY cases in flanged (illustrated), flangeless or flush mounting (round or square); also in phenol—with black, white or phosphorescent dials; phosphor bronze, alloy steel, stainless steel or K Monel Bourdon tubes; in pressure, vacuum or compound types; in a full range of pressures; all with the Helicoid stainless movement.



Write today
for the Helicoid Catalog

FOUR HELICOID FEATURES

1. Stainless Steel Helicoid Roller (no gear teeth)
2. Stainless Steel Hair Spring
3. Long Life Cam (no gear teeth)
4. Corrosion Resistant Link and Screws

ACCO

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE

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HELICOID Pressure • Vacuum GAGES

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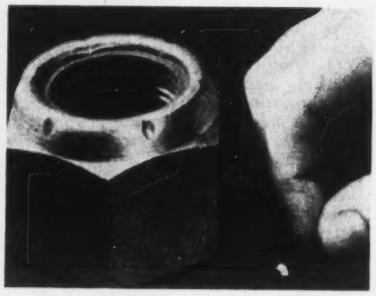
Miniature Elastic Stop Nuts

A new line of miniature hexagonal stop nuts, as small as 0.109 in. across flats, has been introduced by Elastic Stop Nut Corp. of America, Union, N. J. The nuts have nylon locking inserts, and will be available in brass and aluminum.

Believed to be the first integral locking collar type of self-locking nut manufactured to such minute dimensions, they compare with a dimension of 0.250 in. across flats for the smallest ESNA nut previously made.



The nut is expected to find wide use in specialized applications, particularly in the electronics and instrumentation fields. They make precise adjustments whether the nut is tightened against a seating surface or simply located at any predetermined point on a threaded member. The nylon locking insert maintains a constant and highly reuseable grip on the screw threads, unaffected by vibration. The simplicity of this one-piece approach is a great production advantage over earlier locking methods such as double nuts, soldering, lock washers, or peening.

Indicated industrial uses include applications in optical instruments, hearing aids, cameras, medical instruments, and clocks and watches.

Cathode-Ray Tube Testing

Development of a new console unit for testing electrostatic cathode-ray tubes completely, accurately and quickly is announced by the Cathode-ray Tube Div. of Allen B. Du Mont Laboratories Inc., Clifton, N. J.

The new unit, designated as Type 2166, is intended for production testing. The Type 2166 can test electrostatic tubes for: breakdown and stray emission, astigmatism, spot or raster cutoff, spot examination, line width, deflection factor or sensitivity, leakages, angle between traces, deflection plate cutoff and base alignment. In essence, it can perform all electrical tests required by JAN-IA. Simultaneous displays and interaction tests of dual-beam cathode-ray tubes, such as the 5SP, can also be made.

For speed and ease of testing, the unit has a plug-in adapter for each type of tube or series of related types. When changing from tube to tube, the appropriate adapter is inserted in the tube compartment, making it unnecessary to clip any leads on tubes by hand as has been the practice in the past. An engage-disengage device operated with a single hand movement makes contact or disconnects the tube electrically during mounting and dismounting, thereby protecting the operators from danger of shock. Further protection is provided by a complete system of interlocks.

Keep Informed

NEW EQUIPMENT
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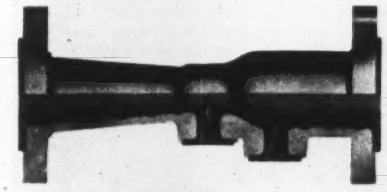
Saran Lined Venturi Nozzle

Builders-Providence, Inc., 345 Harris Ave., Providence, R. I., announces their new Saran lined venturi flow nozzle, model NZSL. This nozzle is a venturi styled differential producer for use in metering and controlling flow of corrosive fluids. Saran, a product of the Dow Chemical Co., is ideally suited to and has been thoroughly tested for corrosion resistance. The Saran lined differential producer allows wider use of "continuous processes" instead of "batch processes". Such chemicals as sulphuric acid, nitric acid, ethyl alcohol, and other solvents including oils and latex can be metered with assurance against corrosion.



Silicone Chemical

A new silicone chemical developed by General Electric's Chemical Div., Pittsfield, Mass., is now being made available to laboratories for experimental purposes. The move, it was stated will place at the disposal of research centers throughout the nation one of the most interesting silicone products yet produced.

Now in pilot-plant production at G-E's Waterford, N.Y., silicone plant and available in drum lots, the new silicone is unique in that it is water soluble. It can be applied directly to surfaces or used as an integral mix to impart water repellency to a variety of materials. It can also be used as a chemical intermediate in the manufacture of water repellents or other chemical materials where the properties imparted by silicones are desired.

Described as sodium methyl siliconate, General Electric's silicone development has a variety of potential applications in numerous industries. Although the major use for the product at this time is for masonry water repellents, it was stated that developmental work conducted at Waterford indicates that SC-50 may make significant contributions to other fields. These include water repellents for textiles and paper products, catalyst preparations, water-repellent aerogels, additives for sodium silicates, and additives for water-base paints to improve washability.

SC-50 is noninflammable, noncorrosive, and odorless. Being water soluble it can be incorporated with concrete during the mixing process to impart water repellency, and it makes limestone and gypsum water repellent, whereas other silicone materials are often ineffective.

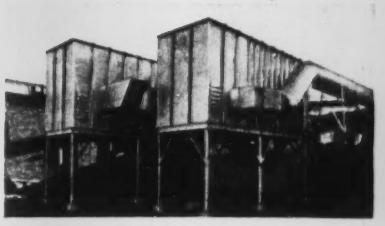
Supplied as a liquid with 20% silicone solids content, (31% total solids), SC-50 is light amber in color and can be cured at ambient temperatures. By following suggested handling instructions, it can be dried to a white powder which can be redissolved in cold water.

This big Pangborn "CH" Collector, at Garden City Foundry, Stoughton, Wis., serves the foundry's grinding wheels and its Pangborn Blast Cleaning Machines. Result: Plant and equipment are protected from excess abrasive dusts, and employees work in a dust-free area!

GOT a DUST PROBLEM?

These Companies Had— and look what PANGBORN did for them!!

Here is the hood and piping system which conveys dust laden air to Pangborn Collectors at Middlesex Silver Co., Middletown, Conn. Valuable silver fines recovered with this system are worth $15,000 a year, after all operating costs of the system have been paid!



This one Pangborn installation solved six dust control problems for Kingsbury Machine Tool Co., Keene, N.H. Heating costs have been lowered substantially through recirculation of cleaned air, costly dust damage to machinery and products has been prevented, and workers' efficiency has increased!

THE THREE EXAMPLES you see here are actual case histories of dust problems solved by Pangborn Dust Control Equipment. In each case, Pangborn engineers studied the problem, recommended a solution, and worked closely with plant supervisory personnel in securing the greatest benefits possible from the dust control equipment.

Not that these examples are unusual; they're typical of Pangborn's day-to-day operation. Improving working conditions, removing dust hazards, improving community relations, saving money through reclamation and salvage of the dust collected—these are Pangborn's stock-in-trade—these are the benefits literally thousands of plants are enjoying, thanks to Pangborn.

What are your Dust Problems? Find out what Pangborn can do to solve them. Write for Bulletin 909A. Address: PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md.

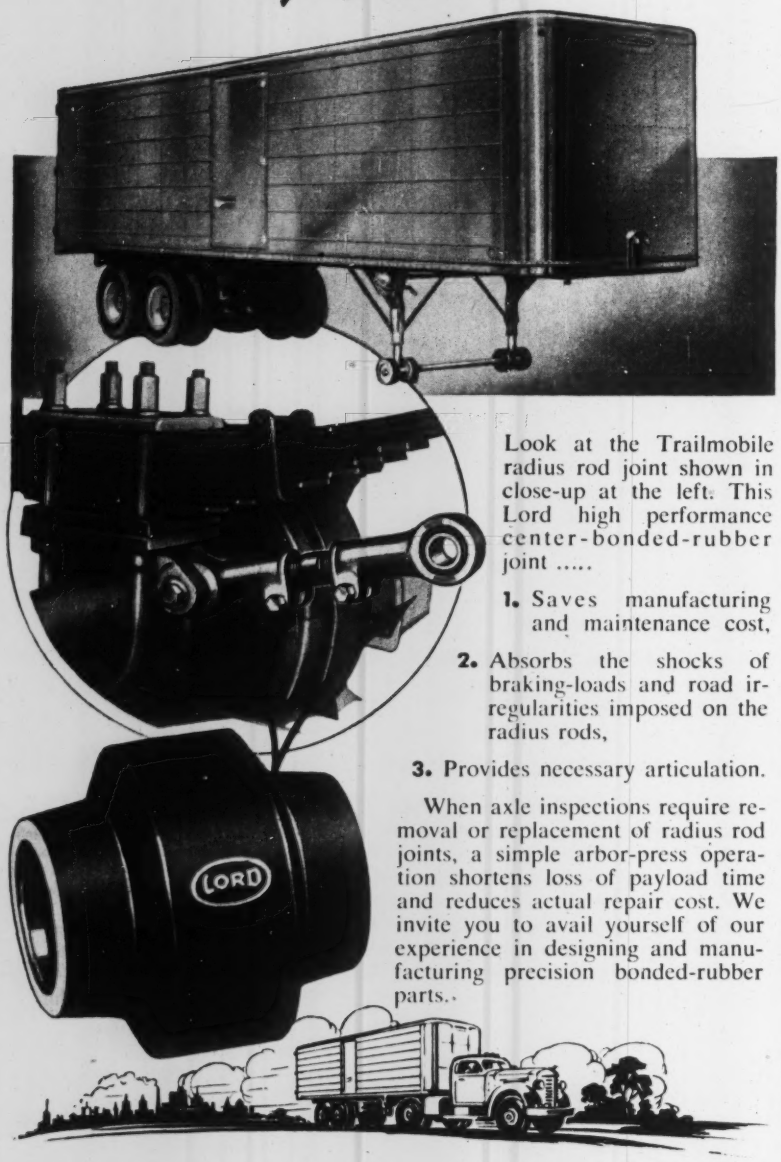
Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment

Pangborn DUST CONTROL

STOPS THE DUST HOG from stealing profits

TRAILMOBILE

RADIUS ROD JOINTS *by* LORD



Look at the Trailmobile radius rod joint shown in close-up at the left. This Lord high performance center-bonded-rubber joint .....

1. Saves manufacturing and maintenance cost,
2. Absorbs the shocks of braking-loads and road irregularities imposed on the radius rods,
3. Provides necessary articulation.

When axle inspections require removal or replacement of radius rod joints, a simple arbor-press operation shortens loss of payload time and reduces actual repair cost. We invite you to avail yourself of our experience in designing and manufacturing precision bonded-rubber parts..

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LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER

Headquarters for **VIBRATION CONTROL**

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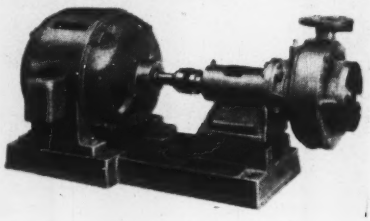
Chemical Transfer Pump

A chemical transfer pump, characterized by the use of a mechanical shaft seal in place of the usual stuffing box and by use of a stainless-steel alloy for the wetted end, has been introduced by Peerless Pump Div., Food Machinery and Chemical Corp., 301 West Ave. 26, Los Angeles 31, Calif. The new pump, Type CTB, is made available for continuous or intermittent duty in transferring process chemicals, including acids, bases, salts, organic, and inorganic solutions in all concentrations. Practically all the requirements of low temperature and low pressure chemical transfer service can be met with this type pump, the manufacturer states.



Characteristics of the Type CTB pump include horizontal end-suction, top discharge design, with a vertically split case. Built in four sizes, capacity range is from 10 to 250 gpm; head range is from 10 to 140 ft; hp range is from 1 to 10. Temperatures of liquids handled can be up to 250 F max. Materials of construction include cast-iron frame and a liquid end of type No. 20 stainless-steel alloy. This type alloy has a chrome-nickel content of approximately 50%.

The new pump is designed for and built with a mechanical shaft seal of Peerless Pumps' own design and manufacture to virtually assure prevention of leaks along pump shaft. The use of a mechanical shaft seal reduces shaft overhang, bearing loads, and shaft run-out at the seal—and, as a result, effects a sizable reduction in both seal and pump costs.

Another design feature is the use of a semi-open type impeller, with repelling vanes cast on the back of the impeller shroud. Repelling vanes assure the pump having maximum slurry and abrasive handling capabilities.

Chain-Tow System

Freight-handling problems are solved and costs reduced by a chain-tow system in operation at a new freighthouse on Chicago's near-south side. The system processes 34,000 tons of freight a month with very little traffic interference and few maintenance problems.

Designed and installed by Lamson Corp. of Syracuse, N. Y., this 2100-ft-long system is capable of keeping 175 platform trucks in constant motion around a 1000-ft × 50-ft closed rectangular circuit. More than 95% of the freight handled is hauled on this chain-tow.

On line haul, a total of 485 men unload a daily average of 350 platform trucks. Approximately 50 box cars are loaded and 30 unloaded each day. In addition to handling cargo from some 200 city trucks, about 70 over-the-road trucks are unloaded and 55 loaded daily.

Tow hooks are spaced at 12-ft invervals on the conveyer. Platform trucks on these

hooks carry freight from 35 box cars (on stub tracks) and from as many as 139 motor trucks (backed up to the platform) to any other car or truck in the freighthouse. Handlers merely unhook empty trucks as required, load them, mark destinations on a panel provided for the purpose on the front of each truck, and then hook them back onto the continuously moving tow chain.

At the proper destination a handler unhooks those trucks marked for his station. After he has emptied each truck he hooks it back on the chain for some other handler at some other station to pick off and use.

The chain-tow moves at about 123 fpm. Platform trucks make a complete circuit of the freighthouses in 18 min. Two 20-hp motors, at diagonally opposite corners of the system, furnish the driving power. Switches every 200 ft along the circuit permit workers to stop the chain at any time to adjust improperly stacked loads or to permit lift trucks to cross the line.

Usually about 125 to 175 platform trucks are attached to the chain at one time. However, a reserve stock of 700 trucks is maintained for emergency rush operations or for live storage at busy loading points.

Fork-Lift Trucks

Two completely new fork-lift truck models have been released to industry by the Hyster Co., Portland, Oreg.; Peoria and Danville, Ill. They are an 8000-lb-capacity truck and a 6000-lb-capacity model. Both are gasoline-engine powered and mounted on pneumatic tires.

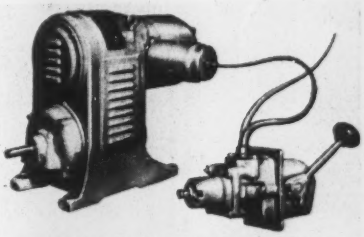
Designed as an ideal "outside" truck, the "ZA-80" (illustrated) is the first heavy-duty 8000-lb industrial truck of its kind that can be operated efficiently indoors as well as out. Special attention was given to operator comfort, ease of daily servicing, and safety. Other outstanding features are shorter over-all length, longer wheelbase, and better weight distribution than usually found in a truck of this size.

The "XA-60" model is a 6000-lb-capacity version of the NA-80 incorporating all the rugged heavy-duty features of the larger truck, but with shorter wheelbase, width and over-all length. The smallest and heaviest 6000-lb-capacity truck ever designed, the XA-60 is distinguished by its compactness, maneuverability, and versatility on the job.

Among the many new mechanical features of both trucks are a long-life clutch that can be completely removed or installed in less than an hour, and large heavy-duty disc-type industrial brakes that eliminate many service and maintenance problems. In addition, both use powerful industrial engines designed especially for the grueling work lift trucks are subjected to. Both trucks were thoroughly tested for two years in industry under actual field conditions before being released.

Pneumatic Remote Control

Variations in speed of U. S. Varidrive motors by pneumatic remote control are now possible through a recent development of U. S. Electrical Motors Inc., 200 East Slauson Ave., Los Angeles 54, Calif. This control consists of a positioning unit—an air operated plunger attached to the Varidrive speed-changing device and an air valve which remotely controls the positioning unit. Four types of valves are available depending upon the method desired to operate the mechanism—pedal, lever, cam, or wheel. The positioning units are designed to operate with an air pressure of either 60 or 100 psi.



Through the use of check valves and control station selectors in the system, the speed of the Varidrive can be changed from any number of control stations. Conversely, any number of Varidrives may be controlled by one station providing they are to operate at the same speeds.

If desired, the pneumatic control may be used to provide speed changes from one preset finite speed to another by one quick movement, allowing the minimum amount of time and effort on the part of the operator.

Punch Presses

Two new power-operated punch presses, each with a rated capacity of five tons, have been added to the Di-Acro line of precision metalworking machines—manufactured by O'Neil-Irwin Mfg. Co., 569 Eighth Ave., Lake City, Minn. Both presses will punch a 4-in.-diam hole in 16-gage (0.062-in.) sheet steel or a $^3/_8$-in. hole in $^3/_{16}$ in. steel plate.

A feature of these machines is their deep throat. Because of this, many operations can be performed on them that could not be done on shallow, bench type presses.

Advantages of these new punch presses are: (1) High rate of production—180 strokes a minute. (2) Minimum operator fatigue on long production runs. (3) Simple to operate—foot control frees both of the operators hands for work handling and positioning. (4) Safety—all moving parts are housed in a welded steel cabinet. This also results in greater work visibility for the operator. (5) Quick setup—complete line of punches and dies are available for these machines; it is a simple matter to change from one operation to another. (6) Compact—each machine occupies a floor space of 17 × 28 in. (7) Portable—need not be bolted down; net weight of No. 1 model is 540 lb, of the No. 2 model, 715 lb. (8) Material chute—is built into cabinet for delivery of slugs and blanked parts.

The flywheel on these machines is driven by a $^1/_2$-hp electric motor. Choice of a single-phase 110–220 volt, or a three-phase 220–440 volt, a-c motor is offered.

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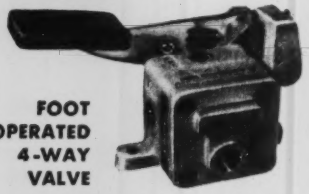
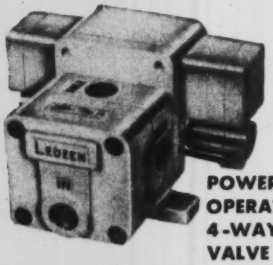
HAND OPERATED 4-WAY VALVE

Three models: Completely Manual—Spring Return to Neutral—Spring Return to Reverse. Flow cycles to handle most requirements.



FOOT OPERATED 4-WAY VALVE

Same as Hand Operated Valve, except foot operation replaces hand. Leaves hands free for other work.



POWER OPERATED 4-WAY VALVE

For remote control, safety or automatic equipment. Suitable for solenoid, cam, finger, toe or hand operation.

Ledeen valves are built in sizes from ⅛" to 1¼" standard pipe tap—to operate air and hydraulic cylinders and motors, single and double acting.

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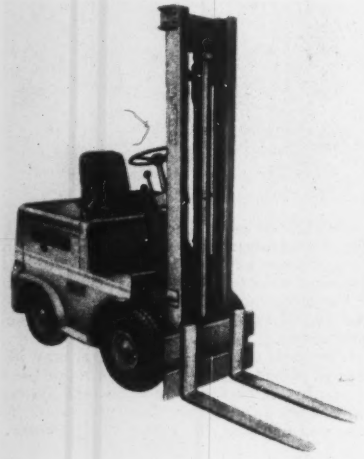
Improved Fork Truck

Several important improvements feature the new Yardlift "20", pneumatic-tired fork-lift truck of 200 lb capacity, announced by Clark Equipment Co., Battle Creek, Mich.

Smooth tilt action and upright stability are proved by twin double-acting tilt cylinders, which replace the single cylinder formerly used.

Honed cylinder surfaces assure positive seal and long packing life. Piston-type construction minimizes leakage and maintenance. Rods are effectively protected from dirt by rubber dust boots.

A convenient instrument panel on the new model is positioned for easy reach and best visibility. It includes all recording dials, ignition switch, and starter button.



Clark's new quick-change clutch, standard on most of its larger models, is another notable improvement in this model.

The Elliott-type steering axle, also standard in larger Clark fork trucks, is an important feature of the new Yardlift "20." The axle is pivoted in rubber torsional bearings to minimize road shock and at the truck frame center to permit constant wheel contact during travel over uneven surfaces.

Literature on the new Yardlift "20" may be obtained on request to Clark Equipment Co.

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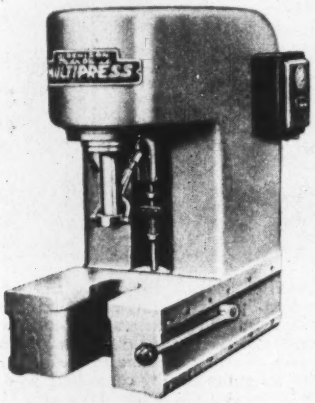
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Press "Touch Control"

A new versatile type of control, now available on their widely used Multipress, has just been announced by The Denison Engineering Co., Columbus, Ohio. To be known as "Touch Control" it is a servo-type valving in the oil hydraulic press circuit that through its unique linkage with the hand control gives "instant response" ram action. Extremely close control over ram speed is accomplished through a hand control lever. Whether the lever is pressed rapidly or slowly, the ram follows up to its maximum speed. To any kind of up and down hand motion—long, short, fast, slow—the ram responds instantly. Minimum ram stroke is about $^1/_{16}$ in.; maximum, 6 to 15 in., depending on the model Multipress—neither the valving nor linkage restricting the stroke or daylight of the press.



It works as follows: The hand lever is depressed which raises the shipper rod; this motion is transmitted through the clevis and yoke to the valve spool. The spool rises, opens the pressure port of the valve and the ram descends. The ram pulls the telescoping arm down at the same time. This tends to return the spool to its original closed position. The ram stops and remains stationary in a "neutral" position until the control lever is moved again.

When the ram contacts work, it exerts just as much force as your hand dictates. The "Touch Control" gives the operator a "feel" that is second only to the use of his own hand directly on the work if he were strong enough to do it. The pressure gage on the press tells him the exact force needed to perform a certain job. For production line work the press can then be accurately set for continued application to that job-required pressure.

Other reported advantages of this "Touch Control" is that it allows fast ram approach to work—and then when the ram contacts the work, it can be inc' d carefully (avoiding sudden impact) to provide maximum safety for tooling and fixtures. It offers desirable controllability for varying conditions of die fill, material thickness, etc., as well as straightening, die try-outs, lab testing, and certain types of assembly—in fact, any job that requires careful and individual control of ram speed and pressure.

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HORIZONTAL AND VERTICAL ARE STRICTLY
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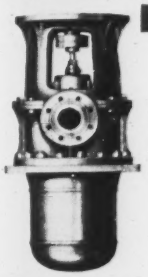
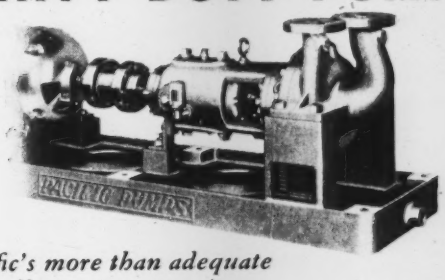
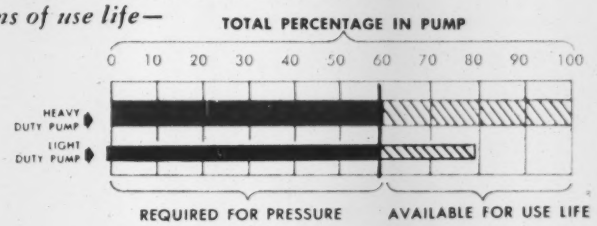
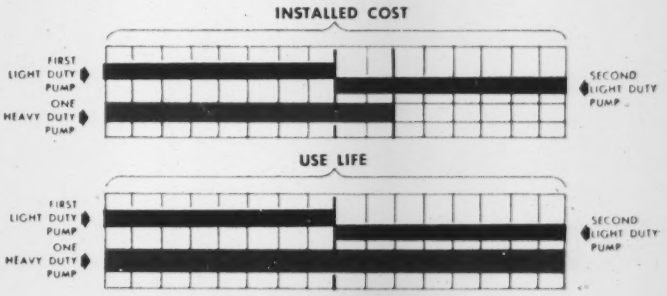




Here is what Pacific's more than adequate corrosion-erosion allowance means in terms of use life—


TOTAL PERCENTAGE IN PUMP
0 10 20 30 40 50 60 70 80 90 100
HEAVY DUTY PUMP
LIGHT DUTY PUMP
REQUIRED FOR PRESSURE
AVAILABLE FOR USE LIFE

Here is why Pacific's heavy duty process pumps are more economical—



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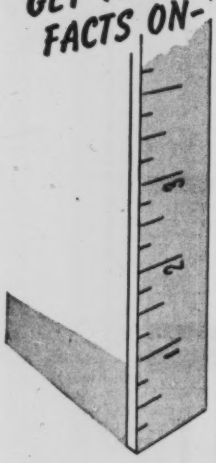

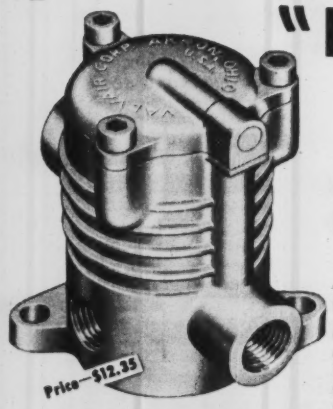

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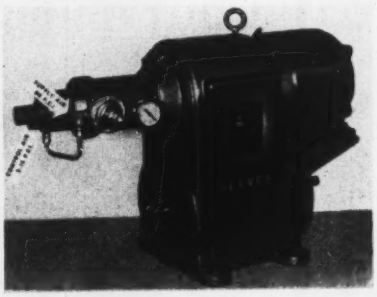
Motodrive with Conoflow Control

Reeves Pulley Co., Columbus, Ind., announces the addition of the Conoflow Control to its present line of automatic controls available.

The Conoflow Control is available on all integral horsepower Reeves Vari-Speed Motodrives for use in conjunction with instrumentation air pressure of 3 to 15 psi. The integral horsepower Vari-Speed Motodrives with the new Conoflow Control have 6 to 1 maximum speed ranges on all units with capacities to 25 hp.

The present hydraulic and pneumatic controls still are available on the Vari-Speed Motodrives in addition to the new Conoflow cylinder.



Addition of the Conoflow Control permits the Vari-Speed Motodrives to control liquid levels in tanks, whether of the open or enclosed types. In addition, the Conoflow Control makes it possible to use the Motodrive for automatically controlling flow proportioning systems of liquid, gas, chemicals, grain, etc., as well as pressure and temperature.

Connection is made direct to the Conoflow Cylinder on the Drive from a penumatic controller.

The Conoflow Cylinder is prelubricated and no outside lubrication is necessary. This type Control may be operated from the present air supply in a plant, and it can easily be connected to any pneumatic control instrument.

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JANUARY 2 TO 31

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A victory against cancer now may mean protection for you later. Won't you help us by giving freely—giving generously—giving now? Mail your contribution to "Cancer" care of your local post office.

Help us fight your battle
Give to the
Cancer Crusade of the

AMERICAN CANCER SOCIETY

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NEW EQUIPMENT
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Magnetic Flowmeter

A new device, called a magnetic flowmeter, for the remote measurement of molten-metal flow, has been announced by the Special Products Section of the General Electric Co.

Designed so that its sensing element is external to the flowing liquid, the new flowmeter offers maximum safety and protection where hazardous metals, such as sodium, lead-bismuth, and sodium potassium alloys must be metered.

According to engineers, one of the basic features of the new flowmeter is that it eliminates all movable parts and physical obstructions to fluid flow. It consists essentially of a permanent magnet with a pipe centered between the magnet pole faces by means of stainless-steel supports.

As the molten metal flows through the pipe, it cuts the magnetic lines of flux set up by the magnet. This generates a small directional voltage in the pipe proportional to the amount of magnetic flux and the rate of metal flow. The voltage is picked up off the pipe by two stainless-steel wires and transmitted to an instrument showing the prevailing flow rate or a recording meter providing a permanent record of flow rates.

Since any potentiometer-type indicating or recording instrument can be used to measure the millivolt output of the flowmeter, the measuring instrument itself is not normally furnished with the equipment.

The sensing head of the new device is $3 \times 5\frac{1}{4} \times 6$ in. and will accommodate flow in pipe sizes of $\frac{1}{2}$, $\frac{3}{4}$, or 1 in. A length of stainless-steel pipe $2\frac{1}{2}$ ft long is provided to assure the required cross-sectional flow distribution over a wide range of installation conditions. Accuracy of the magnetic flowmeter is $\pm$ 3%.

Additional information on the G-E magnetic flowmeter is contained in descriptive bulletin No. GEC-875, which is available from the General Electric Co., Schenectady 5, N. Y.

Air-Atomizing Burner

The air-atomizing burner has been refined to simple yet rugged components for efficiently firing Orr & Sembower Powermaster package unit boilers, and trade-named the Voriflow burner. This move has climaxed about eight years of experience and study by the research and engineering staffs of Orr & Sembower, Inc., Reading, Pa., covering rotary cup, mechanical pressure atomizing, and steam atomizing, as well as air-atomizing burners.

In the multipass package unit automatic boiler where combustion must be accomplished in the confined chamber of an internal furnace, the burner design is particularly critical. The excellent flame pattern and consistently clean combustion obtained with the air-atomizing Voriflow burner with light through No. 6 Bunker C oils over loads of from 30% to 100% have provided convincing proof of the flexibility of the air atomizing burner.

The rotary cup and pressure atomizing burners frequently used with boilers of this type, are quite sensitive to viscosity changes in fuel. Atomization with heavier fuels is often incomplete resulting in coking on the burner and refractory throat. The drooling and carbonizing, and resultant cleaning and maintenance costs are completely eliminated with the Orr & Sembower Voriflow air-atomizing burner.

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When you have an insulated piping problem, remember that only the best will give you ALL the advantages necessary to full-efficiency performance of your system. That means Ric-wiL Prefabricated Insulated Piping.

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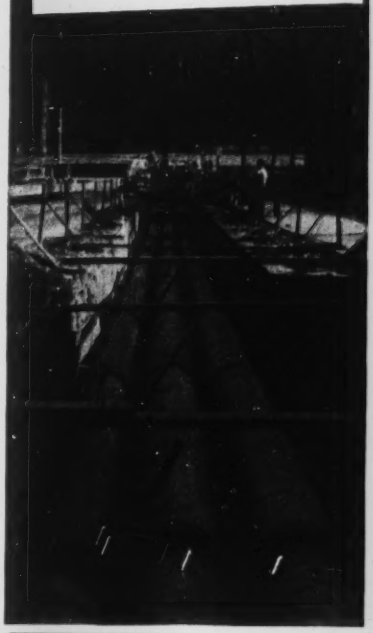

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- NO LUBRICATION
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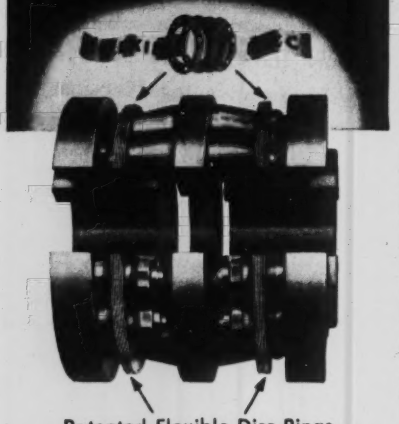
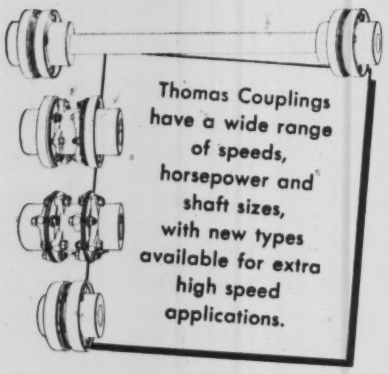


Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.



Thomas Couplings have a wide range of speeds, horsepower and shaft sizes, with new types available for extra high speed applications.

THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT

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ALL PARTS ARE SOLIDLY BOLTED TOGETHER

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THOMAS FLEXIBLE COUPLING CO.

WARREN, PENNSYLVANIA. U.S.A.

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Both rotary cup and mechanical pressure atomizing burners are difficult to throttle down to low firing rates with any reasonable efficiency while the newly developed Voriflow burner holds full efficiency from the 30% lower limit up to full 100% load. Control of combustion air is difficult with the normal result that larger quantities of excess air than necessary are utilized.

Mechanically, the pressure atomizing burner and the rotary burner with its multiplicity of moving parts, motor, belt or other drives, and high velocity rotating cup are outclassed by the simplicity of the air-atomizing Voriflow burner. The beryllium copper body holds the stainless-steel cap over the multiple slots in the stainless-steel core forming converging flow paths for the atomizing air. Only about 1% of the total full load combustion air is thus admitted with the oil for atomization which permits much closer control of the combustion air from the blower and the resultant high efficiency at light loads. Fuel oil flows through the central oil tube and is picked up at multiple injection points by the individual air streams. The dams near the end of the oil tube prevent dripping after shut down. The beryllium copper body and the brass air tube conduct heat back to the plenum where it can be quickly dissipated at low temperature.

Bulletin 1218 describes Powermaster packaged unit boilers equipped with Voriflow air-atomizing burners in 16 sizes from 15 hp to 500 hp for pressures to 250 psi.

Aluminum Coating

A new industrial aluminim coating, that can be sprayed without spattering objects or surfaces four feet or more in the background, has recently been placed on the market by Royston Laboratories, Inc., Blawnox, Pa., after a two-year period of test-proving.

Because of the special vehicle and solvents selected for the formulation of the new coating, Roylac Aluminum, it dries upon four feet of travel from the spray gun nozzle to a cottony, nonadhering powder.

As an example, a wire fence was spray-coated with Roylac, and simultaneously with another high-quality aluminum paint. Identical air pressures and spray guns were used. The spraying of Roylac left no coating or spattering on a tar paper background, which was not the case with the other material.

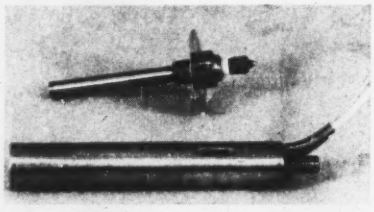
In addition to this valuable feature, Roylac provides a superior and tightly bonded corrosion-resistant film with a bright aluminum finish, particularly effective exposed to acid-type fumes and salt or moist air.

The material is plasticized to provide a film of good flexibility and bonding tack, effective for sealing wood or other porous surfaces. With its nonreactive vehicle the coating is excellent on galvanizing, zinc, aluminum, magnesium, steel, and other basic metals. It has been accepted as an economical, fast-drying product finish coat. It covers 600 to 800 sq ft per gal and dries to a tack-free film in 12 min. The material is also easily applied by brush.

ONE BANNER
under which all may serve

Midget Thermostat

A redesigned midget Thermoswitch, whose heat-sensitive shell has an outside diameter of only 1/4 in., has been released by Fenwal Inc., Ashland, Mass., specifically for those applications in which precision temperature control or overheat detection must be provided in solids, liquids, or gases where space is at a premium. With improved performance characteristics, the midget thermostat is adjusted and sealed at the factory to any temperature set-point in the range from −50 F to 450 F and has an inherent sensitivity of 0.1 F. Rated at 1 amp at 48 volts ac or 32 volts dc, it is compared in the photograph to a standard Fenwal cartridge thermostat, which has a shell diameter of 5/8 in.



In the photo, the midget Thermoswitch, an inverse compression type in which the contacts close with temperature rise, has a hex head, 1 1/4-in. removable nameplate, 1/8-27 pipe thread and 1 29/32-in-long stainless-steel shell (over all length is 3 9/32 in.). The thermostat is also available with a straight thread. Other models, with both regular and inverse contact arrangements, will soon be in production. Although the volume of its shell is only one-twelfth that of standard Fenwal units, the midget unit retains such operating characteristics as built-in temperature anticipation, fast reaction time, high resistance to mechanical vibration and shock, short heat transfer path, wide operating range, and uniform sensitivity.

Hysteresis Brake

An improved hysteresis brake that holds constant tension on yarn, wire, etc. by magnetic drag instead of friction has been announced by the Control Dept. of the General Electric Co., Schenectady, N. Y.

The brake consists of Alnico magnets so designed and mounted that a magnetic drag (or hysteresis effect) offers a restraining force on a pulley. This force is essentially constant at all speeds and can be adjusted simply by turning the calibrated head mounted above the pulley.

The restraining force of the magnets assures minimum abrasion on the yarn since the material is always in contact with the revolving pulley and is not rubbed or drawn over the surface.

According to G-E engineers, the new brake reverses the direction of rotation a few degrees after stopping, thereby holding stalled tension. The inertia of the brake itself is slight enough that yarn does not become unthreaded during quick acceleration and deceleration.

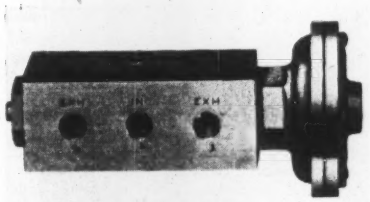
The construction of the brake permits operational speeds up to 700 yd per min while tension control ranges from 3.5 to 10.5 grams.

Applications for the device include tension control for synthetic and natural yarns as well as rubber, glass-fiber, and small-diameter wire.

Diaphragm Valve

Newly introduced by C. B. Hunt & Son, Inc., Salem, Ohio, the Quick-As-Wink diaphragm-operated spring-return single-plunger valve is for use when only low-pressure air is available for the pilot control. These valves can be operated with instrument air at pressures of from 12 to 35 psi on the diaphragm and consequently are well-suited for use in development and research laboratories, and all types of industrial and commercial applications where only low-pressure air for the pilot control is available.

These diaphragm valves are low in price. They feature sturdy construction, simplicity in design, and ease of operation. All parts are carefully balanced. The valve housing is aluminum. The stainless-steel plunger is hollow with precision placed radial ports. The spring return is placed under the diaphragm push plate permitting open end exhaust if desired.



The manufacturer reports that the improved design prolongs the life of the packing and valve parts, reducing repairs and maintenance to a minimum; and that the valves can be completely disassembled and reassembled in a few minutes without disturbing the main piping.

Furnished tapped for either $\frac{1}{8}$ or $\frac{1}{4}$-in. pipe connection, in 2-way; 3-way; double 2-way; 4-way; and 5-way designs for use with air, oil or water at line pressures up to 125 psi—also vacuum—at normal temperatures, (not exceeding 150 F).

Foundry Sand Dryer

The first reclamation system for foundry sand featuring a vertical sand dryer without moving parts has been installed in the Buffalo plant of Worthington Corp. according to a recent announcement. The $75,000 system promises to save Worthington a considerable sum, it is reported.

Feature of the new system is its drying tower where the reclaimed sand is dried after passing through an elaborate washing and classifying process. This component on the equipment, known as a vertical sand dryer, has been made without moving parts for the first time in America.

Systems which reclaim waste foundry sand for re-use in cores and moldings are not new to American industry. But in the past the dryers on these systems always have come equipped with many complicated moving parts, with the result that users frequently have encountered difficult maintenance problems.

The vertical dryer in the new equipment, however, largely eliminates this problem and introduces a new technique into foundry sand reclamation work. To date, only one other installation anywhere in the world uses a similar dryer—that being an installation at the Rosenlew Company in Finland.

Manufactured by the Hydro-Blast Corp. of Chicago, the new system will reclaim up to 5 tons of used foundry sand per hour. It works roughly like this:

As sand is washed from the foundry castings, it flows into a large and slowly revolving cylindrical screen. Through its revolving action, this screen breaks up any sand lumps which have formed, and its fine meshing effectively removes any foreign bodies which may have collected, such as gaggers and lumps of coke.

Passing through the screen, the sand is combined with water and pumped as a slurry into a six-unit classifier which removes the silt. Coming out of the classifier, it drops into a storage bin, from which it is passed through a special cylinder for removal of excessive water.

Thus washed and ready for drying, the sand is elevated to the top of the drying tower. It falls naturally through this tower, passing slowly through a series of hot air ducts which have been built in rows through the complete height of the dryer. By the time the sand reaches bottom, it is clean and dry.

A variable-speed screw conveyer at the bottom of the dryer next transfers the sand into a bucket elevator. This elevator raises it to a second conveyer belt traveling over a magnetic pulley. The belt transports the sand to a storage bin above the sand mixer, at the same time removing any remaining metallic particles.

So deposited in the storage bin, the sand is ready to be metered out for additional use as foundry needs require. The entire system works on automatic controls. Power is supplied by 13 different electric motors, ranging in size from 1 to 15 hp.

Waveguides

Presently undergoing extensive in-field testing at Andrews Air Force Base, Washington, D. C., for inclusion in the world-wide U. S. Air Force microwave communications system, "Waveflex" flexible waveguides, manufactured by Titeflex, Inc., Newark, N. J., are being installed wherever shock mounting or movement are present in equipment. Because their flexibility frequently results in lower installation costs than are possible with rigid waveguides, Waveflex components are gaining increasing usage even when movement is not present in the installation.

Waveflex waveguides have been found most useful in installations where: (1) connections are made between stationary and moving components; (2) flexibility of the tubing permits ease of assembly; (3) flexibility of the tubing improves design; (4) an expansion joint is needed to compensate for temperature changes and to relieve pressure on other parts of the equipment.

The flexibility of Waveflex permits complicated bends, twists, and small radii bends with practically no change in electrical properties. If necessary, a Waveflex assembly can be bent in the *E* plane around an arbor having a diameter as small as two times the major axis of the waveguide and in the *H* plane around an arbor having a diameter as small as three times the major axis of the waveguide. Confinement in very small spaces is possible without distortions of critical dimensions. Where repeated flexing of the guide is necessary, Waveflex will give long life and still maintain its electrical properties. Waveflex assemblies have been flexed

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SHOCK AND VIBRATION INSTRUMENTATION 1952 $3.00

A collection of seven papers dealing with applications of shock and vibration instruments for various services, and problems encountered in their design.

DESIGN DATA 2 VOLUMES 1944

CONTENTS OF VOLUME 1, STRENGTH OF MATERIALS $1.50

Stress and Deflection of Circular Plates. Stress Deflection of Rectangular Plates. Circular Beams Loaded and Normal to the Plane of Curvature. Thermal Stress. Torsional Stresses in Shafts having Grooves or Fillets. Factors of Stress Concentration Photoelastically Determined. Stresses in Pressure Vessels. Press- and Shrink-Fitted Assemblies. Working Stresses. Formulas for Calculating: (1) Load, Deflection, and Stress in Helical Compression and Tension Springs, and (2) for the Design of Piping.

CONTENTS OF VOLUME 2, MECHANICS $1.50

Vibration Problems. Balancing of Rotating Apparatus. Harmonic Coefficients of Engine Torque Curves. Shortening the Time of Applying Theoretical Formulas to Solving the Common Design Problems of Uniform, Flat, and Circular Plates. Result of Calculation for the Deflections and Moments in Rectangular Plates with Hydrostatic Loading. Circular Beams Loaded Normal to the Plane of Curvature. Formulas for Calculating Loads, Rotation, and Deflections of Quarter Bends and Tangents of Pipes.

MODERN REHEAT TURBINES AND BOILERS 1952 $2.00

Aspects of reheating treated include design, progress and service experience; advantages and disadvantages of the reheat cycle; normal start-up, quick start-up, normal operation, and shutdown of modern reheat boilers under normal or emergency conditions; and design factors relating to their performance and operation; special features of operation of several new reheat boilers; conversion to centralize control of auxiliaries; reheat steam temperature control; turbine overspeed control as affected by reheat; and reheat development during the past twenty-five years.

GAS TURBINE PLANT HEAT EXCHANGERS 1951 $3.00

Provides much needed basic heat transfer and flow friction design data for compact heat exchanger surfaces. Included are descriptions of the 34 surfaces considered, test results, dimensions and a scale diagram for each surface, examples of heat exchange performance calculations, etc.

PRINCIPLES OF OPTIMALIZING CONTROL SYSTEMS AND AN APPLICATION TO THE INTERNAL COMBUSTION ENGINE 1951 $2.00

CONTENTS: General Principles of Operating Systems. Methods of Realizing Optimum Performance. General Principles of Optimalizing Control Systems. Sensitivity Signal Input Optimalizing Controllers. Continuous Test Signal Optimalizing Controllers. Output Sampling Optimalizing Controllers. Peak Holding Optimalizing Controllers. Recovery Time of Optimalizing Control Systems. Output Hunting in Optimalizing Controllers with Operating Component Response Delays. Output Hunting Loss. An Experimental Peak Holding Optimalizing Controller for a Reciprocating Internal Combustion Engine. Summary of the Test of the Experimental Controller.

RECOMMENDED PRACTICES FOR CLEANING TURBINE LUBRICATING SYSTEMS 1952 $1.00

Makes available procedures with respect to the preparation of new turbine lubricating systems, the cleaning of lubricating systems after service, and the preparation of turbine oils. Recommendations are based on information furnished by turbine builders, operators, oil suppliers, and consulting engineers.

SMALL PLANT MANAGEMENT 1950 $6.00

This practical Guide to know-how management is based on a study of small plant activitizs in different industries throughout the country. It thoroughly treats every significant management topic from the principles of scientific management to financing; banking; accounting; legal requirements; taxes; labor relations; unions; plant planning; organizing; operating and controlling; and obtaining best facilities, materials, productivity, and sales.

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over a million cycles and retained their physical and electrical properties.

Under vibration, Waveflex assemblies are practically immune to damage, due to the damping properties of the molded rubber jacket. Because of the precision fabrication of Waveflex, loss of energy due to reflection is overcome and excellent impedance match is obtained. Critical dimensions of size and shape are maintained to the closest tolerance regardless of twists or bends in the tubing. Voltage standing wave ratios are well below JAN-W-287 specification requirements, and are maintained through bends up to 180 deg.

Phase shift due to bending is negligible—being comparable to the effect found in rigid waveguides of the equivalent size. Costly transmission energy is conserved by silver-plating the inside surfaces of Waveflex, resulting in lower attenuation loss.

Waveflex waveguides are designed to meet JAN requirements of every application before shipment.

Aluminum Materials-Handling Box

An all-aluminum materials-handling box has been designed by Aluminum Company of America. The box measures 60 × 42 × 36 in. and is of welded construction, using 61S alloy sheet and extrusions. Welds are made by either inert gas shielded arc or the sigma process.

Five hundred of these boxes are in use at Alcoa's Cleveland, Ohio plants. There they serve a dual purpose, handling finished products or as a scrap box. Mounted on low runners, they may be lifted by fork trucks and carried, stacked, or turned over and the contents dumped. The runner is formed like an I-beam for added strength. Tiering lugs make stacking an easy matter.

Weighing 245 lb, the box will carry a 5000-lb load. A comparable steel box weighs 620 lb. In addition to the aluminum box's lightweight, another big factor is its natural resistance to corrosion and corrosive fumes. The aluminum carried in this box is thus not subject to contamination by red rust stains. The boxes were made for Alcoa by Powell Pressed Steel Co., Hubbard, Ohio.

JANUARY 2-31
GIVE *Voluntarily* TO
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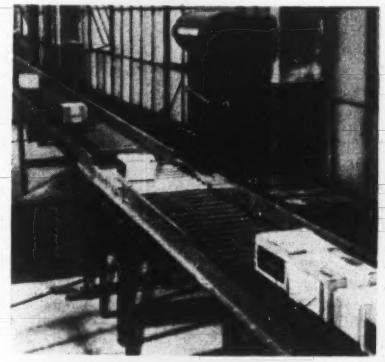
Shipping Scale

In order to avoid extra handling of outbound cartons before shipment, it is an easy matter to integrate a scale into the conveyer line which leads from production or storage to shipping. Lamson Corp., Syracuse, N. Y. recently made an installation in a gum factory shown in the photograph.



With no waste motion or detours, cartons of gum now move down the roller gravity conveyer line and arrive at the scale section where they are checked for proper shipping weight. After the weight has been verified the cartons move on down the line to be shipped.

This basic principle of including the scale within the conveyer system can be adapted to many types of products and many fields.

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Steel mills and foundries need more scrap.

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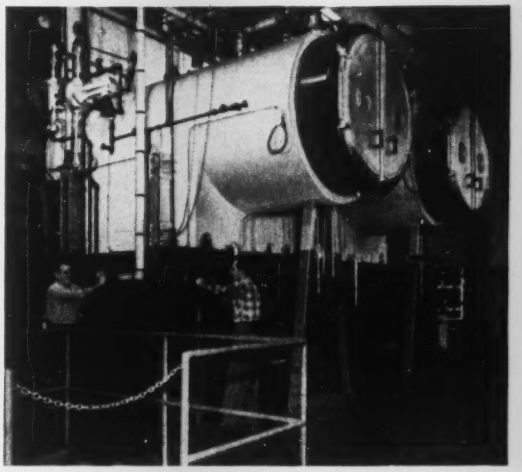
Search *your* plant for this idle metal . . . work with your local scrap dealer to increase supplies of badly-needed iron and steel scrap.

What to look for . . .

obsolete machines, tools and equipment, no-longer-used jigs and fixtures, worn-out or broken chains, wheels, pulleys, gears, pipe, tanks, drums and abandoned metal structures. Non-ferrous is needed, too!

SALVAGE FOR AID DEFENSE MORE SCRAP TODAY... MORE STEEL TOMORROW

MORE ENGINEERING MORE MATERIAL MORE EXPERIENCE MAKE THE DIFFERENCE



KEWANEE STEEL BOILERS

Set a Kewanee alongside other boilers and even a quick look shows their extra ruggedness, finely finished castings and other evidences of a high quality product. Then look inside! Check the specifications, measurements, size of fire chamber, area of heating surface and one finds many other differences. More engineering, more material, more labor and more experience go into every Kewanee . . . whether for heating, power or process steam . . . so owners *get more from them.*

With experienced engineers and mechanics on their staff, a great air line knows mechanical equipment. So it means much when concerns such as Northwest Air Lines install Kewanee Boilers in an important building.

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Optional range of minimum-maximum adjustment — to 3000 psi — without changing spools.

Now you can have full-scale regulation of your adjustable speed circuits *regardless of pump delivery.* No need to order individual valves for each circuit requirement. One valve does the job. Denison Flow Control Valves can be adjusted to various pump deliveries, quickly and simply, *without changing spools.* Simplified, cartridge-type single-spool design makes these rugged valves ideal for meter-in, bleed-off and other operations at all circuit pressures to 3000 psi. *For extra safety, valve bodies are built to withstand 5000 psi.* Twelve models, 2-port and 3-port types, with or without built-in check, in sizes of 1/4", 3/8" and 3/4". 0 to 28 gpm capacities. Write today for full details!

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A COMPLETE LINE OF PUMPS, PUMPING UNITS, FLUID MOTORS, CONTROLS

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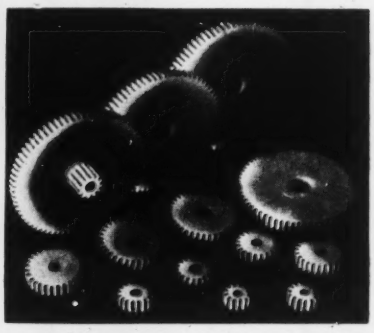
Nylon Gears

Molded nylon gears are now carried in stock for immediate delivery by the Nylomatic Div. of John A. English & Co., Morrisville, Pa.



Available is a line of spur gears in 48 diametral pitch, 14½ deg pressure angle, ranging from 12 to 80 teeth. Also, not in stock but available on special order from stock molds is a large selection of unit-molded 48-pitch gear and pinion combinations for use in speed-reducer applications. In the near future similar lines in 64, 32, and 24 diametral pitch gears will be offered.

Nylomatic gears give quieter operation, wear better, allow greater tolerances in center locations and cost about half as much as their counterparts in metal.

Business Notes

Barco Constructs New Plant

A new plant for Barco Mfg. Co., is being constructed at 500–530 N. Hough St., Barrington, Ill., for occupancy early in 1953. The new structure will provide 103,000 sq ft of floor space for offices, manufacturing, and other facilities, including a modern cafeteria for employees.

Alcoa Plans Alaska Construction

Aluminum Company of America will undertake the construction of a $400-million aluminum smelting project in Alaska as soon as the necessary land can be purchased and government approvals obtained.

It was pointed out that such an ALCOA-Alaska project would initially be capable of producing 200,000 tons of aluminum annually.

The Alaskan smelting facilities, and electric power developments necessary to operate them, would be situated in the Taiya Valley district, near Skagway, Alaska. Financing of the project would be done entirely with private capital.

The project would be the largest in Alaska to provide employment every day of the year, and would be a great step forward in the industrial development of the territory, he stated.

He estimated that the Taiya development would require about four years for completion, and would eventually offer employment for approximately 4000 people when full-scale operations were under way.

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B & W Plans New Boiler Plant

Announcement that The Babcock & Wilcox Co. had purchased facilities of a former shipyard from the Brunswick Port Authority at Brunswick, Ga., and would convert it into a plant to build boilers and related equipment was made recently.

The property involved consists of about 110 acres with about 250,000 sq ft under roof. The plant has not been used since the end of shipbuilding and will require considerable rehabilitation. This work, together with installing the necessary new equipment, will start immediately, and production will start about the first of the year and build up to an employment of 400 by mid-1953.

This is the fourth new plant to be announced by the company in the past year, the other three being at Wilmington, N.C., West Point, Miss., and Paris, Texas.

Diatomite Movie

Johns-Manville, recently completed a 16-mm, 36-min, sound film in full color covering its diatomaceous silica products called Celite.

The title of this motion picture is, "Celite, The Story of How Johns-Manville Puts the Diatom to Work." It explains how the Celite diatomite deposit was created over 5 million years ago, how Johns-Manville mines this unusual material and converts it into usable forms, and how the unique properties of Celite are put to work. The camera takes you into various industrial plants where Celite is used as a filter aid, shows some of the ways in which Celite mineral fillers improve products and processes, and points out other interesting Celite applications.

This film may be borrowed without charges from any of the 17 Johns-Manville sales offices located throughout the United States and Canada.

Carbide & Carbon to Build New Plant

Design and engineering work are underway, and Certificates of Necessity have been issued by the Defense Producton Administration, for a new plant in Los Angeles, Calif., for Carbide and Carbon Chemicals Co.

The Company, which is a Division of Union Carbide and Carbon Corp., plans to produce polyethylene resins at this new plant. The plant also will produce ethylene glycol. The project, according to the Certificates of Necessity, will involve an eventual investment of upwards of $36 million. It is being designed to produce from 50 to 60 million lb of polyethylene and from 5 to 10 million gal of ethylene glycol a year.

The new Los Angeles plant, the exact location for which has not yet been announced, will be the first plant on the Pacific Coast to manufacture polyethylene and ethylene glycol. It is expected to supply the needs for these materials for the West Coast and the Mountain states. Carbide's new plant will not contribute to the air pollution problems of the Los Angeles area since no acids will be used whatever in the chemical operations involved, and no fumes will be given off. Natural gas will be used as a fuel for the boilers and, as a consequence, no more smoke will be produced than is generated by gas refrigerators or the gas stoves used in homes.

DENISON Pilot-Operated Check Valves

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"The Finest Money Can Buy!"

4 models, ½" to 1½" sizes . . . 3000 psi maximum
Standard Subplate or Threaded Body Types

Another milestone in Denison's continuing program of research and development in oil-hydraulic equipment! Denison's new pilot-operated HydrOILic Check Valves are compactly built for circuits operating at pressures to 3000 psi. Improved and simplified high pressure design. Replaceable valve seats add to maintenance economy. Capacities up to 50 gpm. ½", ¾", 1¼" and 1½" sizes are available, in standard subplate or threaded body types. Let us send you complete information on this new line of Denison HydrOILic Check Valves . . . Write today for new bulletins.

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ALCOA's New Plant Dedicated

Top government defense agency officials joined with Aluminum Company of America executives and Washington State dignitaries on September 13 to dedicate the nation's newest aluminum producing unit built by ALCOA at Wenatchee, Wash.

The coming of the ALCOA project to Wenatchee has made possible the creation of over 150,000 kw of new firm power in the Northwest at a critical time in the country's defense program.

The $45,000,000 smelting works is said to represent the largest investment of private capital for manufacturing facilities made at one location at one time in the State of Washington.

The new smelting works is located along the Columbia River, 13 miles south of Wenatchee, in the heart of Washington's famed fruit-growing country.

The plant will have a capacity of 170,000,000 lb of aluminum annually.

Latest Catalogs

Bottled Gas-Fired Furnaces

Bottled gas-fired furnaces for melting joint compound, asphalt, tar and similar materials, are fully described in Bulletin 1077, published by Hauck Mfg. Co., Brooklyn 15, N. Y. Available in pot capacities of 4, 10, 15, and 25 gal, the new gas-fired furnaces, have enclosed burners with a wide range of heat regulation. Economical to operate. No flame impinges on pot, insuring even heating and long pot life. No delays due to carbon.

Smoke and Combustion Indicators

Of special interest to marine and industrial engineers is this latest Ess Instrument Co. bulletin No. 5101 that describes the Wyd-Angle Smoke Periscope possessing a 90-deg vision angle and the "Cat's Eye" Furnace Indicator. Diagrammatic and cross-section drawings, together with suggested installation sketches, are included. While the use of periscope applications of smoke and combustion indicators is somewhat limited, they do offer an unusually effective means of transmitting, instantly, time and effort-saving smoke density readings from remote points. Copies of the bulletin available on request from Ess Specialty Corp., 96 South Washington Ave., Bergenfield, N. J.

Motor Drives

Allspeed motor drives of from $\frac{1}{3}$ to $7\frac{1}{2}$ hp are described in a 16-page bulletin published by Worthington Corp., Harrison, N. J. Described and pictured are both upright and horizontal drives of either closed or skeleton types. Sixteen pictures graphically portray the ease of belt change. Discussed are such problems as service, electric motors, torque, bases, adverse operating conditions, shaft variations, and mounting. Two pages of selection tables, one page describing "how" to select the proper drive, and one page each on operation and maintenance are included. Dimensions and line drawings on the various drives are also featured.

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Metering Applications

A 20-page booklet describing metering applications for watthour meters is available from the General Electric Co., Schenectady 5, N. Y. Designated GET-1905, the new bulletin contains circuit wiring diagrams for the various metering applications. It also describes watthour-meter constants and register data, the determination of watts load, and the use of watthour meters with instrument transformers.

Magnetic Materials

A 12-page reprint covers a range of 20 high-permeability materials and 22 permanent magnet alloys. Typical properties are given in table form and comparative information is discussed in the text and illustrated by 15 charts. Applications drawn primarily from the communications field illustrate practical usage of the various alloys. Available from International Nickel, Dept. EZ, New York 5, N. Y.

Lubrication Systems

A new 4-page two-color illustrated folder, No. 529, has been published by Trabon Engineering Corp., 1814 E. 40th St., Cleveland, Ohio. Pertinent sales points about the application of patented Trabon automatic lubrication system are covered. Includes engineering description of technical methods of operation, in the case of both Trabon's Reversible and Manifold types of lubrication systems.

Power-For-Steel

An extensive 35-page revision of the power-for-steel booklet, B-5443, is available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. This booklet concisely reviews past developments in the application of electric power to the steel industry, then describes the advances being made in present-day equipment and processing lines. In many cases, sharp contrast between the old and the new is provided by side-by-side illustrations and text. Among the topics discussed are slip regulators, reversing hot strip mills and cold reduction mills, x-ray thickness gages, and arc furnaces. Characteristics of each type of present-day equipment that are especially advantageous to the steel producer or processor are explained.

Industrial Trucks and Cranes

Catalog 54, a new 8-page booklet in color released by The Baker-Raulang Co., 1230 W. 80th St., Cleveland 2, Ohio, describes and illustrates that manufacturer's line of industrial trucks and cranes. One unique feature of the new catalog is a section titled, "How to Select the Right Fork Truck for Your Handling Job." This section outlines the step-by-step procedure for making the most logical fork truck choice. Other sections in the catalog show at a glance the complete specifications on each Baker product. Specification charts and photos are used to fully describe each model. Also illustrated are the important construction and design features of Baker trucks, and the latest for truck attachments available for Baker equipment. Catalog 54 covers Baker fork-truck models from 1000 to 10,000-lb capacities; high and low-lift platform trucks in 6000 and 10,000-lb capacities; crane trucks in 6000 and 10,000-lb capacities; and Baker's 2000-lb capacity utility truck.

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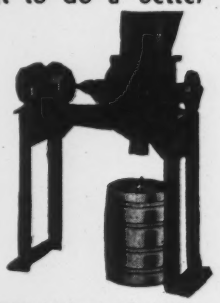
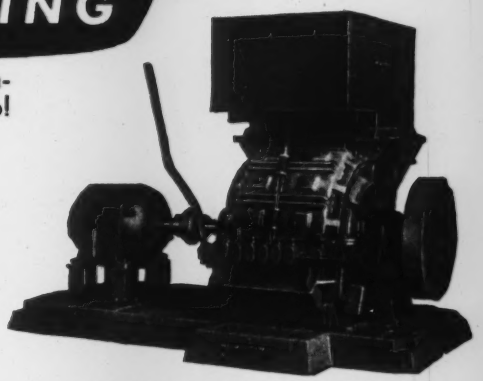


AMERICAN Laboratory Size Mills
With the same reduction action as Metal Turnings Crushers (or hammer action)—American Laboratory Size Mills offer an efficient means for reducing razor blades, pewter castings and fragile thin brittle steel to a reclaim product.



AMERICAN Metals Turnings Crushers
Bulky, hard-to-handle turnings are rapidly reduced as much as 80% with this efficient, economical crusher. And the yield of cutting oil is increased 30 to 50 gallons per ton—proof of how profitable the installation of an American Metal Turnings Crusher can be for those who handle 20 tons or more of metal turnings a month.

There's a custom-built AMERICAN for your operation — write for further data and specifications.

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Originators and Manufacturers of Ring Crushers and Pulverizers
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PROCESS ENGINEERS for work in Tool Engineering Department. Should be capable of preparing component parts and assembly process sheets for small, intricate parts and mechanisms. Two years' experience desirable.

TOOL DESIGNERS for work in Tool Engineering Department. Should have at least two years' experience in layout and design of dies, jigs and fixtures.

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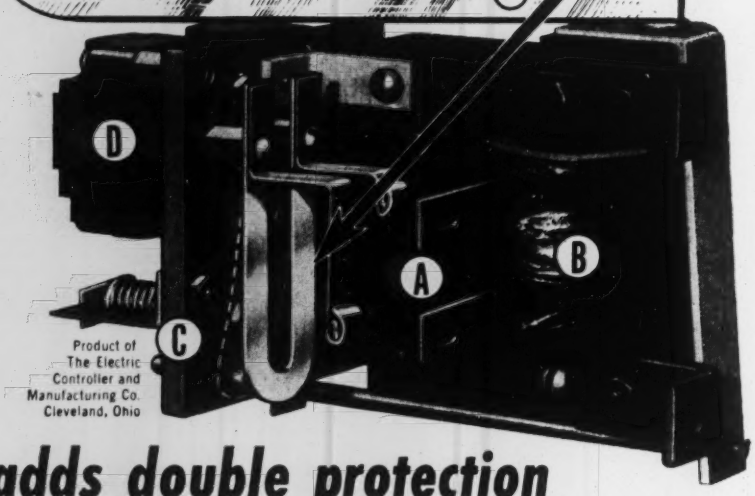
Write, giving full details, including experience and training, to: Mr. P. T. Vanness, Personnel Manager, International Business Machines, Poughkeepsie, New York.

CHACE BIMETAL



Product of
The Electric
Controller and
Manufacturing Co.
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adds double protection
TO EC&M's OVERLOAD RELAY

This type ZTM Overload Relay, manufactured by Electric Controller and Manufacturing Company, combines the dual protection of thermal inverse-time response to motor currents and magnetic instantaneous trip on higher currents. Its use is with squirrel cage, synchronous and wound-rotor motors, providing positive, time response to overloads, protecting the motor from overheating. For 600 volt systems or less, the relay is connected directly into the motor circuit. Higher voltages require a current transformer in addition to the relay.

Thermal protection is obtained by a flat "U" shaped element of Chace Thermostatic Bimetal. The bimetal is placed directly across the secondary (A) of a saturable-core current transformer. When the motor current passing through the primary winding (B) is excessive, the bimetal element heats up and pushes the stud on the trip lever (C) which in turn opens the contacts in the micro-switch (D). The motor is thus removed from the line and the bimetal element is de-energized. As soon as the bimetal pressure on the trip lever assembly is relieved, the micro-switch closes automatically and returns the motor to normal operation. A spring adjustment is provided on the trip lever to set the relay at any value between 110 and 125 percent overload.

Chace Thermostatic Bimetal is manufactured in 29 types, in strips, coils, random long lengths and welded or brazed sub-assemblies. We also provide specialized tooling necessary to fabricate bimetal elements to customer designs. Before proceeding with your next design, consult our Application Engineers, recognized authorities on temperature responsive devices—or write today for a copy of our new 32-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing condensed engineering data.

IT BENDS WITH THE HEAT

W. M. CHACE CO.
Thermostatic Bimetal
1619 BEARD AVE., DETROIT 9, MICH.

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Shell Molding Process

To help users of the new shell-molding process obtain uniform blending of fine sand and phenolic shell-molding resins, the Patterson-Kelley Co., Inc., 390 Warren St., East Stroudsburg, Pa. offers a new four-page bulletin on twin-shell blending. The special bulletin, based on successful P-K Twin-Shell Blender installations in shell-molding foundries, explains and illustrates how properly to blend resin-sand mix. Valuable information is given on charge, order of charge, mixing time, and discharge characteristics of sand and resins mixed for shell molding in the twin shell blender. Blender features are illustrated and described in detail, particular emphasis being given the unique removable "intensifier bar" which uniformly disperses kerosine or other dust-suppressant liquid.

Stainless Tubing Steels

Two economical stainless tubing steels having the attributes of resistance to corrosion and oxidation, and also the ability to be hardened by heat-treatment to develop good mechanical properties, are discussed in a new technical data card, TDC 143, issued by the Tubular Products Div. of The Babcock & Wilcox Co., Beaver Falls, Pa. The bulletin discusses B&W Croloy 12 (12% chromium steel—AISI Type 410) and B&W Croloy 12-2 (12% chromium, 2% nickel steel—AISI Type 414). Included are condensed technical data on corrosion resistance, mechanical properties, forging, machining, welding, heat-treatment, and physical properties.

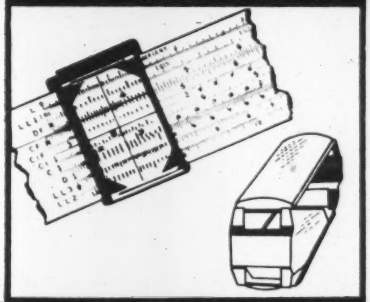
Axivane Fans

Axivane Series 1000 fans are described in bulletin J-611, a 16-page booklet available from the Joy Mfg. Co., Henry W. Oliver Bldg., Pittsburgh 22, Pa. This bulletin explains the advantages of vaneaxial design and the versatility accorded by adjustable blades, for all commercial and industrial applications. The Series 1000 line consists of 136 models, ranging from 18 to 84 in. in diam and producing volumes up to 150,000 cmf at total pressures as high as 11.0 in. wg. Fans are available in 19 housing diameters, 4 hub sizes, and 5 motor speeds. Photographs of typical installations are included, as well as information about Series 1000 special duty units and other Axivane fans. Specification tables showing volume and pressure capacities and physical dimension components are also contained in this bulletin.

Carbide Alloys

Because of continued developments in the field of sintered carbides the Carmet Div. of Allegheny Ludlum Steel Corp. has published the 13th edition of its catalog on various carbide alloys. The new 32-page brochure contains the most recent information on new Carmet production techniques as well as new applications of this hardest of known metals. General information is given on special Carmet grades for machining steel, cast iron, nonferrous, and nonmetallics, and for punches, dies, and wear parts. Lists of available blanks, tools, die sections, punches, and drawing die inserts along with suggested methods for their use are featured in the brochure. Free copies of the catalog are obtainable from Advertising Dept., Allegheny Ludlum Steel Corp., 2020 Oliver Building, Pittsburgh 22, Pa.

SLIDE RULE USERS!



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F. E. G. Duplex Magnifier, with genuine precision-ground glass lenses, gives accurately-magnified readings on *both* faces of duplex rule, *without* having to remove and reverse magnifier. Folds to fit scratch-proof chamois case. Save your eyes! Send for your P. E. G. Duplex Magnifier today!

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DA PRESSURE CONTROLS PROVIDE THE SENSITIVITY YOUR APPLICATION REQUIRES

Available in pressure ranges varying from 30" vacuum to 2,500 p.s.i.

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Hook-On Instruments

A new 8-page booklet describing General Electric's complete line of hook-on instruments is available from the company, Schenectady 5, N. Y. Designated GEC-901, the two-color bulletin contains applications, operation, and basic features of the G-E hook-on type AK-1A volt-ammeter; AK-2 wattmeter; and AK-3 power-factor meter.

Coating Wire Fences

Pictures tell the story in this new industrial folder on the roller method of coating wire fences developed by The Rust-Oleum Corp., 2799 Oakton St., Evanston, Ill. This new roller method cuts wire fence maintenance costs by combining the exclusive penetrating qualities of Rust-Oleum's fish oil base with the speed, saturation, and materials economy of a specially-designed, long-nap, lambs-wool roller. Rust-Oleum's new folder contains a series of "on the job" photographs that carefully illustrate the proper way to apply Rust-Oleum using this roller method. Step-by-step, it shows how to put 99% of the coating on the fence—not on the workers or the ground. Using Rust-Oleum and a special roller, in the manner described in its pages, savings of 30%, 40%, even 50% in some cases, are reported.

Magnetic Alloys

An 8-page, "what is it," "where to use it" booklet on magnetic alloys has been prepared by Westinghouse. The various alloys that are covered in the booklet include Hipernik, Hipernik V, Conpernik, and Hiperco. The first three materials mentioned are iron-nickel alloys while the last is iron-cobalt alloy. These materials provide a wide range of magnetic properties needed for many special requirements. Physical and magnetic property tables together with the availability of each alloy are included. These are accompanied by a discussion of individual alloy heat-treatment techniques. The inclusion of 15 core loss and magnetization curves makes the booklet especially valuable when matching the correct alloy with a specific application. For a copy of this booklet, TD-52-100, write Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Small Vertical Pumps

Construction features of Allis-Chalmers small vertical pumps for sidewall or submerged mounting are described in a new 8-page bulletin. Units covered are available in capacities to 250 gpm at heads to 125 ft for coolant circulating, air conditioning, etc. Sidewall-mounted units are the mechanical-seal, closed-impeller pump (Type RWV and HWV), the mechanical-seal, open-impeller pump (Type CRV), and the mounted, sealless, open-impeller pump (Type KW); Submerged-mounted units are the sealless, open-impeller pump (Type KF), and the sealless, closed-impeller pump (Type RHV). Helpful curves and tables to determine motor frame, horsepower, speed, and current characteristics for the various units are included in the bulletin. Also given are construction details of shaft seals and motors. Copies of the bulletin, "Small Vertical Pumps" 52B6975A, are available from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

154 ideas on ways to use...

154 varied applications of molybdenum sulfide in the shop and in the field are described in a new booklet now available. This solid-film lubricant has demonstrated unique anti-friction properties under conditions of extreme pressure, high velocity, elevated temperature, or chemical attack.

The 40-page booklet contains the records of solved lubrication problems — some might solve your own.

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The lubricant for extreme conditions

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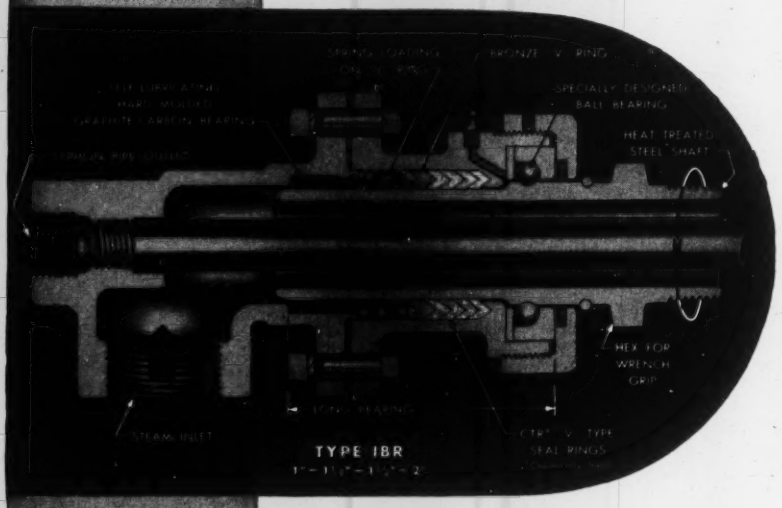
BARCO *Revolving* JOINTS



Syphon Style—TYPE IBR. Built for 450°F., steam service to 150 psi, and up to 500 RPM. Hydraulic service to 200 psi, 750 RPM. Higher pressure and speeds under certain conditions.

Single Flow Style—TYPE IBRSA. Similar to Type IBR. Sizes 1" and larger have 2-piece flange connected body.

Less Maintenance!

PRODUCT DESIGNERS and plant engineers throughout the country have been quick to recognize the ADVANTAGES offered by Barco's new *improved* Type IBR Revolving Joint for service on drum type dryers, coating rolls, calenders, mixing drums, clutches, chucks, chill rolls, sanforizers, and other rotating machinery:

- Free-Floating, Low Torque Installations.
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- Better Temperature Control where steam is used for heating rolls.
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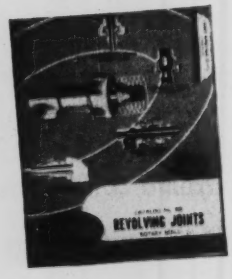

Barco builds a complete line of revolving joints for steam, water, air, oil, gas, and hydraulic service. Sizes from ¼" to 5". Pressures to 250 psi, steam, or 1000 psi, hydraulic. Speeds to 2500 rpm. *Barco Engineers are at your service; ask for recommendations.* BARCO MANUFACTURING CO., 1821B Winnemac Avenue, Chicago 40, Illinois. In Canada: The Holden Co., Ltd.

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Rotary Pump Service

Installation, operation, and maintenance of rotary pumps are covered in a new 12-page service manual. Subjects discussed include installing foundation bolts, alignment, supporting vertical pumps, grouting, piping, suction lines, hot liquid pumps, rotation, packing, dismantling, reassembly, starting, operation, and standing idle; also various charts and sectional elevation drawings. Bulletin 100-2, Warren Steam Pump Co., Inc., Warren, Mass.

Expansion Joint Design Guide

A new 16-page illustrated catalog, CMH-127R, describing all types of Flexon corrugated expansion joints and the basic theory behind expansion joint design, has been released by Flexonics Corp., formerly Chicago Metal Hose Corp., 1305 S. Third Ave., Maywood, Ill. This catalog gives complete specification and installation information for the recently redesigned Flexon line, now capable of handling more pipe-line motion with fewer corrugations, and thus at lower resultant cost. Presented in the catalog are Flexon Free-Flexing expansion joints, for low pressure applications; Controlled-Flexing joints, for absorbing greater amounts of traverse, and Flexoniflex integral-ring expansion joints for extremely high pressure applications. Also covered are dual, hinged, balanced, and bulkhead units.

Process Equipment

Of value to engineers in the processing industries is a new 12-page general catalog offered by the Patterson-Kelley Co., Inc., 390 Warren St., E. Stroudsburg, Pa. The catalog, No. 12, covers dry blending, process, and heat-exchange equipment. Special emphasis is on the twin-shell dry blender which recently has caused many processing firms to revamp their blending methods. Photographs, drawings, tables, and text demonstrate its versatility and effectiveness for thoroughly blending powders, grains, pellets, and flakes in any combination. In addition, the bulletin covers characteristics, applications, capacities, power requirements, and other specification data for twin-shell, double-cone, and ribbon blenders; kettles, evaporators, stills, agitators, autoclaves, pilot-plant units; and heat exchangers.

Dust Collection Units

New pocket-size two-color booklet put out by Pangborn Corp., Hagerstown, Md., illustrates the company's line of small "standard units" for blast cleaning and dust collection applications. Each section lists significant industrial applications, recommends the proper equipment for each, and illustrates the various models of Pangborn equipment. For instance, the blast-cleaning section lists 12 blast-cleaning classifications—plant maintenance, production maintenance, municipal maintenance, renovating, cleaning, grinding, finishing, repainting, decorating, shotpeening dies and molds, generators, and motors—and recommends the right equipment for each job. The same is true for the dust control section, which lists nine classifications—plant maintenance, industrial housekeeping, valuable dusts, product cleanliness, sanitary work conditions, good public relations, salvage, safety, and recommended practice codes and saving heated air.

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New Equipment | *Business Notes* | *Latest Catalogs*

Control Valve Design

"New Techniques in Control Valve Design," is the title of a new 16-page technical bulletin announced by Conoflow Corp. The bulletin covers in concise and readily understandable language a complete review of the development of our present-day conventional control valves and a look-see into the future designs of tomorrow. The bulletin is well-illustrated and fully explains the underlying reasons for today's designs and the logic behind the predicted designs for the future. Copies are available from M. B. Benson, Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.

Flexible Metal Hose

A two-color 16-page product design catalog, CMH-123R, on flexible metal hose and instrument bellows has been released by Flexonics Corp., 1305 South Third Ave., Maywood, Ill. This catalog is pointed specifically to uses of these products by original equipment manufacturers. The bellows section includes detailed information on Flexon stainless steel, brass, and bronze bellows, bellows assemblies, and bellows devices. The hose section features complete specification and application data on convoluted and corrugated types of flexible metal hose, as well as details on flanges, couplings, and other fittings. Also included are CMH assemblies and installation instructions.

Precipitator

A new 4-page bulletin with conveniently arranged information for a quick understanding of the special design features of the Cottrell electrostatic precipitator for the paper industry, has been announced by Research Corp., Bound Brook, N. J., manufacturer of Cottrell electrostatic equipment. The wet-bottom design that reduces time and costs in handling precipitated material, which is a recent and exclusive development by Research Corp., is also explained in the new bulletin. Diagram and complete cutaway view of the equipment shows operating and construction details of the Cottrell precipitator manufactured by Research Corp.

Heat-Treating Equipment

The new general catalog No. 52 of The Pressed Steel Co., Wilkes-Barre, Pa., features the company's line of heat-treating equipment. Generously illustrating the containers, fixtures, and retorts more commonly used in carburizing, annealing, etc., the publication also contains a collection of installation views of new equipment which have interesting possibilities for saving handling and heating time. The catalog also describes the various types of tubing for annealing, firing radiant furnaces, venting noxious gases, and protecting thermocouples, which the company fabricates from any of the complete range of present-day heat and corrosion-resistant sheet alloys.

TS Diesel Bulletin

A new bulletin on the TS Diesel engine has been published recently by Ingersoll-Rand. This 12-page, 3-color catalog incorporates sectional wash drawings, installation views, and diagrams to show why the TS Diesel is called a smaller, lighter, but fully heavy-duty engine. It is a 7 × 8½-in., 900 to 1000 rpm Diesel in the 200-to 400-hp class. Specifications, weights, performance curves, and dimension tables are included in this bulletin, Form 10027, which is available from Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y., or from any branch office.

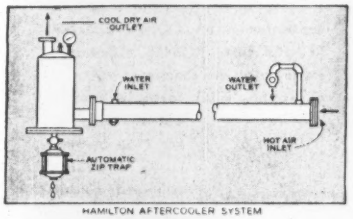
Electronic Controls

Although electronics is a broad and highly technical science, the *application* and *operation* of electronic controls can be readily understood by everyone. With this in mind, Photoswitch, Inc., Cambridge 42, Mass., has prepared a 62-page book for those whose operations will profit by the use of electronic and photoelectric controls.

Each of the 45 case studies describes an industrial control problem which has been solved through the use of electronics. The applications have been chosen from thousands of installations because of their general interest, and because each will suggest related uses in other fields.

To assist in quickly securing useful information, an index lists the applications both alphabetically and by industries.

If you are up in the air about what to buy
Come down to earth where the air is dry.



HAMILTON AFTERCOOLER SYSTEM

MURPHY AFTERCOOLER SYSTEM

The Hamilton Aftercooler System is of the counter current flow design, for the greatest efficiency in cooling compressed air to within a few degrees of the cooling water; the cooled air then enters the regular patented Type A Murphy Automatic Separator where moisture is ejected through the automatic Zip Trap and cool dry air is delivered to the distributing lines.

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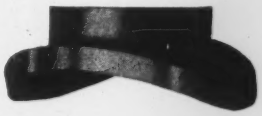
Moisture Elimination Up To 3000 Pounds Per Square Inch



Economy in pilot or development small lots as well as in program production can be achieved by consultation with Lenape for recommendations on seamless or weldment construction requiring:

- **Circular of symmetrical flanged or flued members of ¼" to 4" rolled plate stock.**
- **Upset flanged or plain forged and pierced rings.**
- **Truncated or closed cones.**

Expanded facilities have extended our range of capacity. Mail sketch or print direct, or consult nearest representative.

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Hydraulic Power Units

A new Vickers bulletin No. 52-45 "Vickers Custom-Built Hydraulic Power Units," describes the features and advantages of these power units, which are individually designed as to hydraulic system and cabinet to give the utmost convenience in installation and operation. The new units feature the Vickers hydrogen-brazed "sandwich" panel construction, which by eliminating manifold piping saves space, simplifies installation and maintenance and result in a more compact, cleaner valve panel. The bulletin is available from E. O. Clark, sales manager, Industrial Products, Vickers Inc., 1500 Oakman Boulevard, Detroit 32, Mich.

Cotton Card Drives

A revised booklet, No. B-4596-A, on cotton card drives for the textile industry is available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. Emphasizing the flexibility of individual card drives in contrast to lineshaft drives, the booklet describes and illustrates three types of motors especially designed for card service: (1) the lint-free motor; (2) the totally enclosed motor; (3) the gearmotor. A new lint-tight card controller that has been designed specifically for use with the three types of card motors is also described and Westinghouse sales offices and repair shops in textile industry districts are listed.

Ion Exchange

One of the fields in which ion exchange holds great promise is in the recovery of valuable metals. In a vast number of manufacturing processes, dilute solutions are produced containing metals whose recovery would be most attractive. Valuable information on the subject is contained in a 9-page reprint of a talk "Metal Recovery by Ion Exchange" given by C. F. Paulson, Special Application's engineer, The Permutit Co., 330 West 42nd Street, New York 36, N. Y. Tables, charts, and other data illustrate some of the forms in which industrially important metals are present in solutions and how they might be economically recovered.

Centrifugal Pump Selection

Allis-Chalmers broad line of centrifugal pumps applicable to most industries is highlighted in a new "Handy Guide to Selection of Centrifugal Pumps." In addition to covering general-purpose, double-suction, multistage, special-purpose, marine and mixed and axial-flow pumps, the bulletin has a head-capacity table for single-stage, double-suction Allis-Chalmers pumps. Special-purpose pumps mentioned include solids handling, paper stock, sewage, rubber-lined, process, fractional horsepower, and coolant and circulating units.

Copies of bulletin No. 52C6059J, are available from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

Oil Boosters

Publication of bulletin AD-108 on its new Peak-Temp oil booster has been announced by the Road Machinery Div. of the Cleaver-Brooks Co., Milwaukee, Wis. Illustrated throughout, the bulletin points out the features of the new oil booster, stressing such factors as quicker heating, lower operating cost, quicker shutdown, trouble-free design, and additional oil storage space. Also described are such points as the elimination of water and weather problems, the extra safety provided in the use of the Peak-Temp oil booster and the high degree of efficiency obtainable.

Gear Reducer Selection

D. O. James Gear Mfg. Co., 1140 W. Monroe St., Chicago, Ill., announces publication of catalog 47-B—88 pages of informative engineering data and prices to assist in selection of the proper gear reducer for specific power transmission problem. Catalog 47-B has three subdivisions: (1) Motorized gear speed reducers, a combination of motor and reducer. (2) Motor reducers, assembled on base plate with coupling—a packaged unit; ready for immediate installation. (3) Gear speed reducers, the basic reducer used in these two previously mentioned types. These reducers are accessible and compact and come in 35 sizes in ranges from 3/4 to 75 hp. with ratios of 1.2:1 to 1200:1.

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in the Front Rank of Industry
ON ALL 5 COUNTS

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LONG LIFE • CLEANNESS
SAFETY

Blaw-Knox Steel Grating is electroforged into rigid, one-piece panels, using twisted cross bars for firm footing. Bring your open steel flooring problems to Blaw-Knox for expert help. Bulletin 2365 sent on request.

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OF BLAW-KNOX COMPANY
2105 Farmers Bank Bldg.
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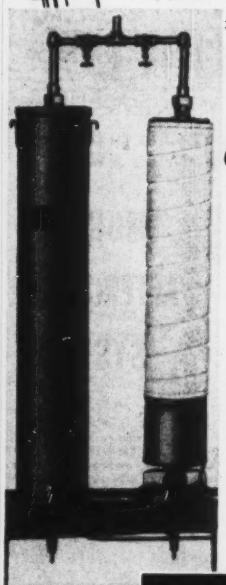
BLAW-KNOX Electroforged STEEL GRATING

KEEP YOUR INSTRUMENTS FREE FROM DIRT AND MOISTURE



HANKISON
Model A-100
Condensifilter

A LOW DEW POINT IS ESSENTIAL for instrument air. CONDENSIFILTERS REDUCE DEW POINTS. Condensing section cools air; condenses water and oil vapors. Filter cartridge removes dirt and solid matter. Trap automatically discharges collected contamination. Model A-100—100 scfm capacity at 100 psig.

Condenser where temperature and dew point are reduced.

Also available — Model B-30-D with a capacity of 30 scfm of free air at 100 psig

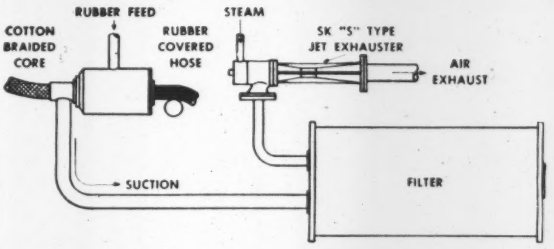
Write For Bulletin A-100

For greater capacity or uninterrupted service, several units can be installed in parallel.

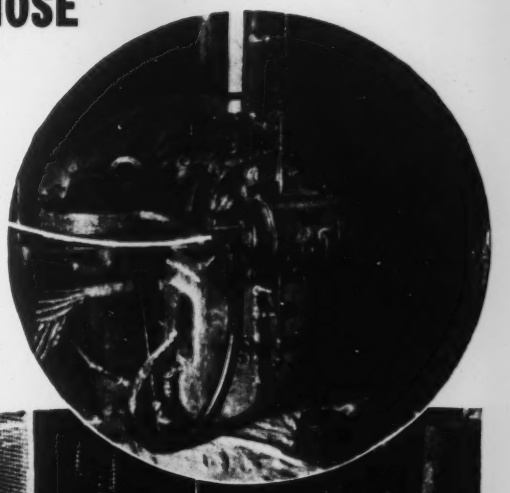
HANKISON Corporation
1009 BANKSVILLE ROAD
PITTSBURGH 16, PA.

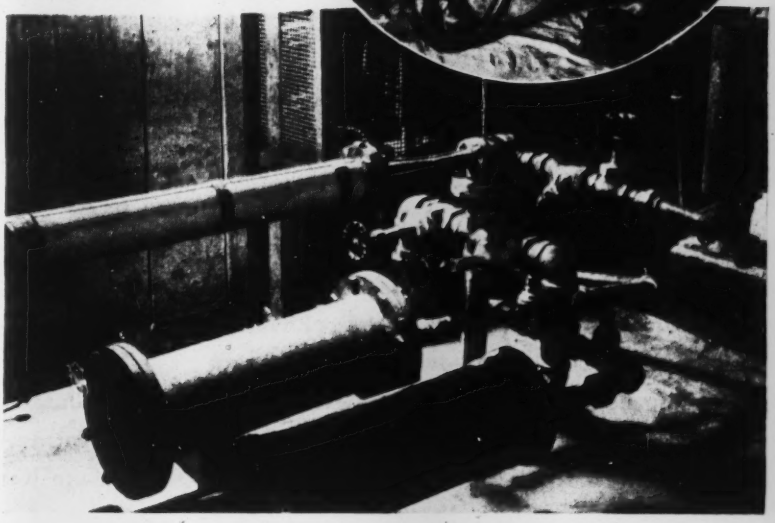
SK News

JET EXHAUSTER CRACKS PRODUCTION PROBLEM IN MANUFACTURE OF RUBBER HOSE



▲ **This diagram shows how Thermoid Engineers applied an SK Jet Exhauster to create required suction.**





As shown above, suction, created by the exhauster (lower photo) draws plastic rubber into the unit and around the hose core.

Jet apparatus, outstandingly simple in construction and reliable in performance, possesses definite advantages in priming, exhausting, evacuating, cleaning, transporting, compressing, and agitating fluids. While already widely used throughout industry, new applications are constantly being developed. Whenever possible, we at SK try to disseminate jet application information to the process industry in the hope that such material may suggest *a means* of solving problems even if not of a directly related nature.

Thermoid Rubber Company engineers recently applied an SK Type "S" Jet Exhauster to a phase of a process designed for use in manufacturing rubber hose. To the part of the manufacturing unit where plastic rubber must be drawn in and applied tightly and uniformly around a braid-reinforced rubber core, they attached a hose. This hose was connected to two filters and was then connected to the suction connection of the exhauster.

Using steam as the operating medium, the exhauster maintains consistently strong suction of 24" 26" Hg. sufficient to cause the rubber to be drawn into the unit and properly applied around the braid-reinforced core.

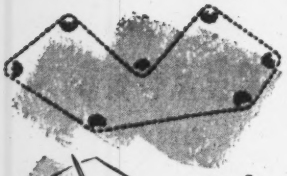
The highly satisfactory performance of the exhauster has practically eliminated production problems during this phase of the operation and has displayed great superiority over the mechanical apparatus previously used.

For our "Index of SK Products" which lists the various technical bulletins describing the many types of SK Jet Apparatus, write to us.

Manufacturing Engineers

If Your Design Problem

design flexibility

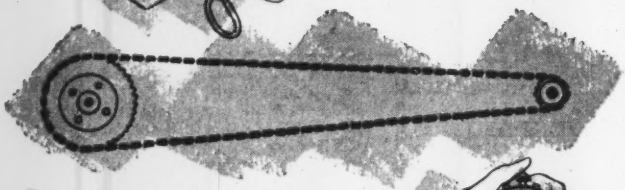


dependability

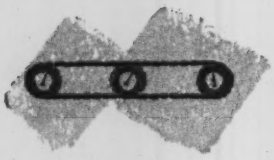
low initial cost

low overall cost

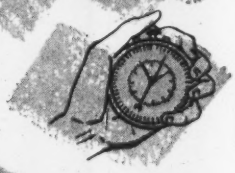
long centers



short

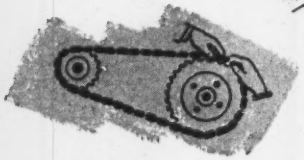


positive timing



heat

ease of installation



long life

Chain Is Your Answer

Yes, chain will solve any of these problems in both drive and conveyor service. The important point is to be sure you select the best chain to do the job. That's why so many designers make their selections from the complete Chain Belt line.

In the complete Chain Belt line there are literally hundreds of sizes and types of chain . . . but only one can be the *best* chain for your particular application. For example: for a high speed drive, Baldwin-Rex® Roller Chain is probably most efficient. For conveying cans, bottles, and jars

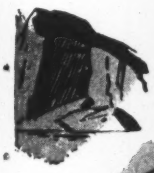
REX

BALDWIN-REX®

Chain

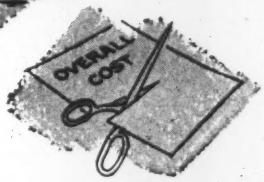
ATLANTA • BALTIMORE • BIRMINGHAM • BOSTON
BUFFALO • CHICAGO • CINCINNATI • CLEVELAND
DALLAS • DENVER • DETROIT • EL PASO
HOUSTON • INDIANAPOLIS • JACKSONVILLE
KANSAS CITY • LOS ANGELES • LOUISVILLE

Involves...



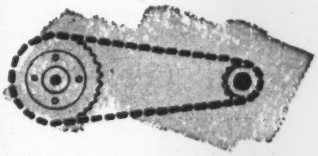
saving weight

saving space



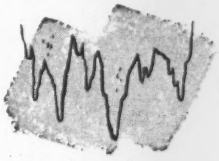
low maintenance cost

centers

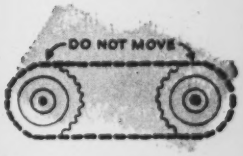


constant speed ratios

cold



fixed centers



resistance to dirt, grease, grit

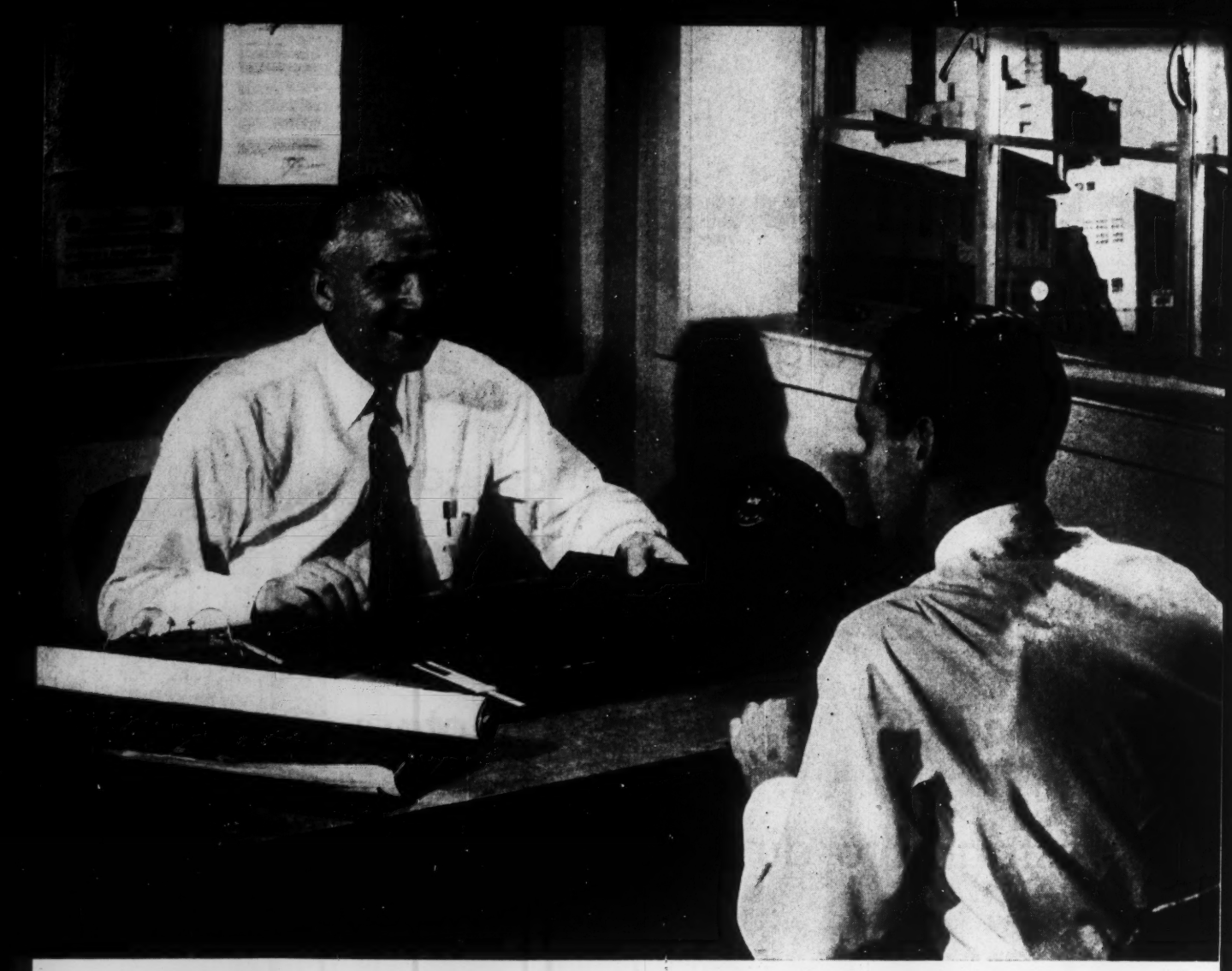
you choose between Rex TableTop® and Baldwin-Rex PlateTop, depending on load conditions; where loads are heavy and chain must operate in dust and dirt, some type of Rex Chabelco® is usually indicated.

Our Rex Field Sales Engineers are specially trained to help you with your chain selection problems. For more help, call your nearest Chain Belt branch office or write to Chain Belt Company, 4765 W. Greenfield Ave., Milwaukee 1, Wisconsin.

Belt COMPANY
OF MILWAUKEE

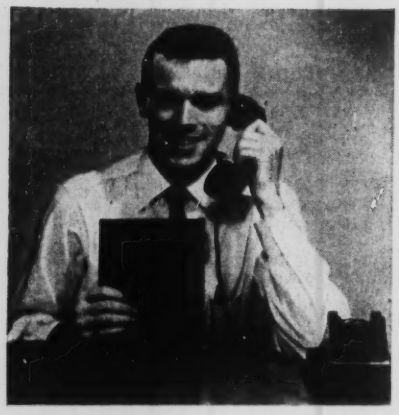
MIDLAND, TEXAS • MILWAUKEE • MINNEAPOLIS
NEW YORK • PHILADELPHIA • PITTSBURGH
PORTLAND, OREGON • SPRINGFIELD, MASS.
ST. LOUIS • SALT LAKE CITY • SAN FRANCISCO
SEATTLE • TULSA • WORCESTER

Chain Belt Company 52-101
4765 W. Greenfield Ave.
Milwaukee 1, Wis.
Gentlemen:
My chain selection problem is.....
.....
Please send me appropriate literature.
Name.....
Company.....*Dept*.....
Address.....
City.....*State*.....



When you have a water conditioning problem—the first thing to do is call

cochrane



Whether your requirements are large or small, call a Cochrane Water Engineer. Supported by his recommendation, you'll be sure you're right.

. . . water conditioning is a problem for specialists. The Cochrane people specialize in water engineering and water conditioning equipment. And since Cochrane manufactures all types of water treating equipment their recommendations are unbiased. Cochrane engineers will show you how to obtain most economically the quality of water you want. Call Cochrane first when you have a water conditioning problem.

THERE'S A COCHRANE SOFTENING PROCESS TO GIVE YOU THE WATER YOU WANT

When you have a water softening problem—Cochrane Water Engineers can give you the right answer. Through many years of experience in all types of water treatment—including ion exchange—Cochrane offers five distinct processes, each with specific advantages for a particular job:

Hot Zeolite Process
Sodium Zeolite
Hydrogen Zeolite
Dealkalization
Demineralization

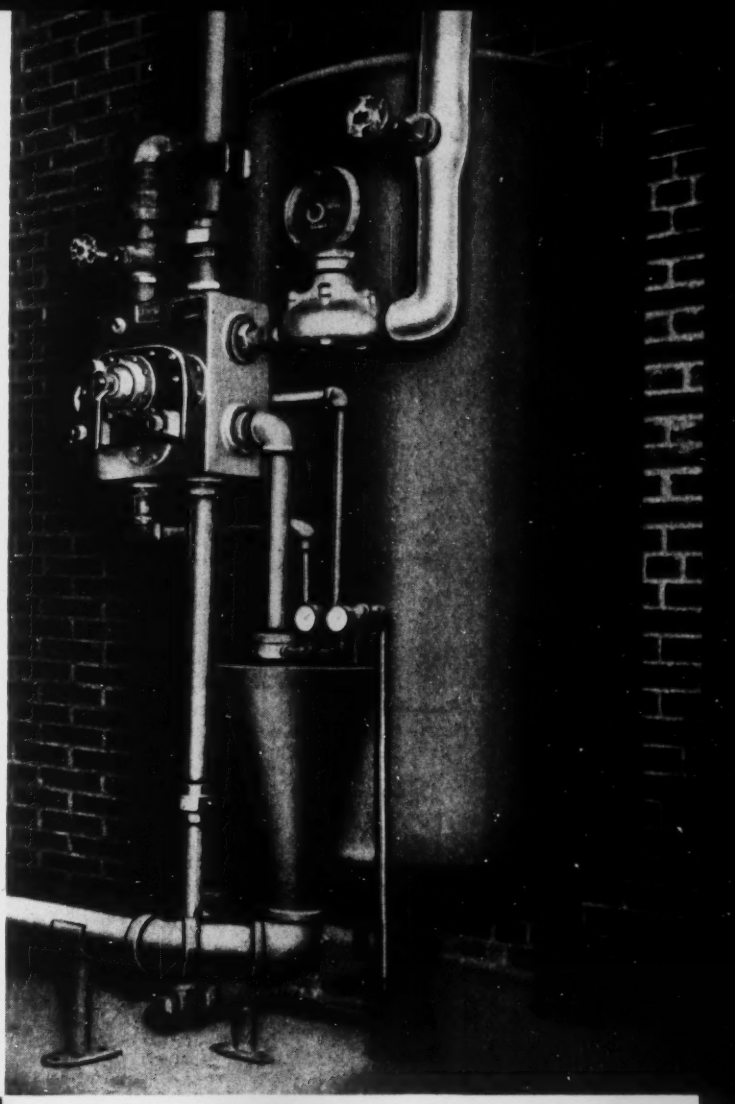
A Cochrane Water Engineer will be glad to explain the differences in these processes. He'll show you how the one process best suited to your requirements will provide water of the quality you want, cheaply and abundantly—from any raw water.

COMPLETE DEAERATION OF BOILER FEEDWATER

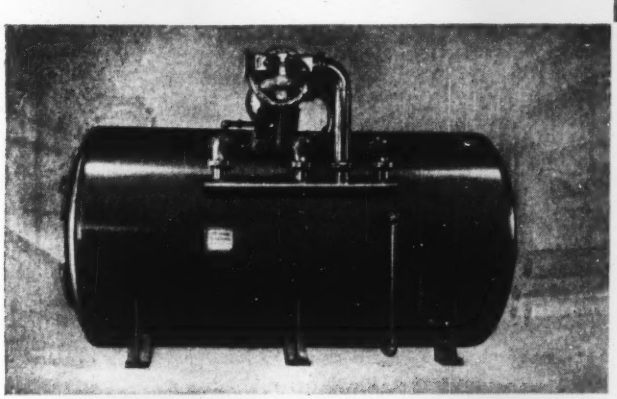
Cochrane provides all types of Deaerators to meet any requirements:

Tray-Type Deaerators
Atomizing Deaerators
Deaerating Hot Water Generators
Cold Water Deaerators

One of these units can be applied to your particular boiler feedwater requirements and built of materials suited to your service. A Cochrane Water Engineer will bring you the benefit of Cochrane's long experience in conditioning boiler feedwater.



Cochrane Zeolite Softener installed with a HYDROMATIC Single Control Valve.



Cochrane Tray-Type Deaerator for Central Station installation in the Southwest.

Cochrane equipment covers the full range of water conditioning:

HOT PROCESS SOFTENERS
HOT AND COLD ZEOLITE SOFTENERS
DEAERATORS & OPEN HEATERS — DEMINERALIZERS
DEALKALIZERS — DEGASIFIERS
REACTORS & CLARIFIERS
CONTINUOUS BLOWOFF SYSTEMS
STEAM SPECIALTIES — CONDENSATE RETURN SYSTEMS

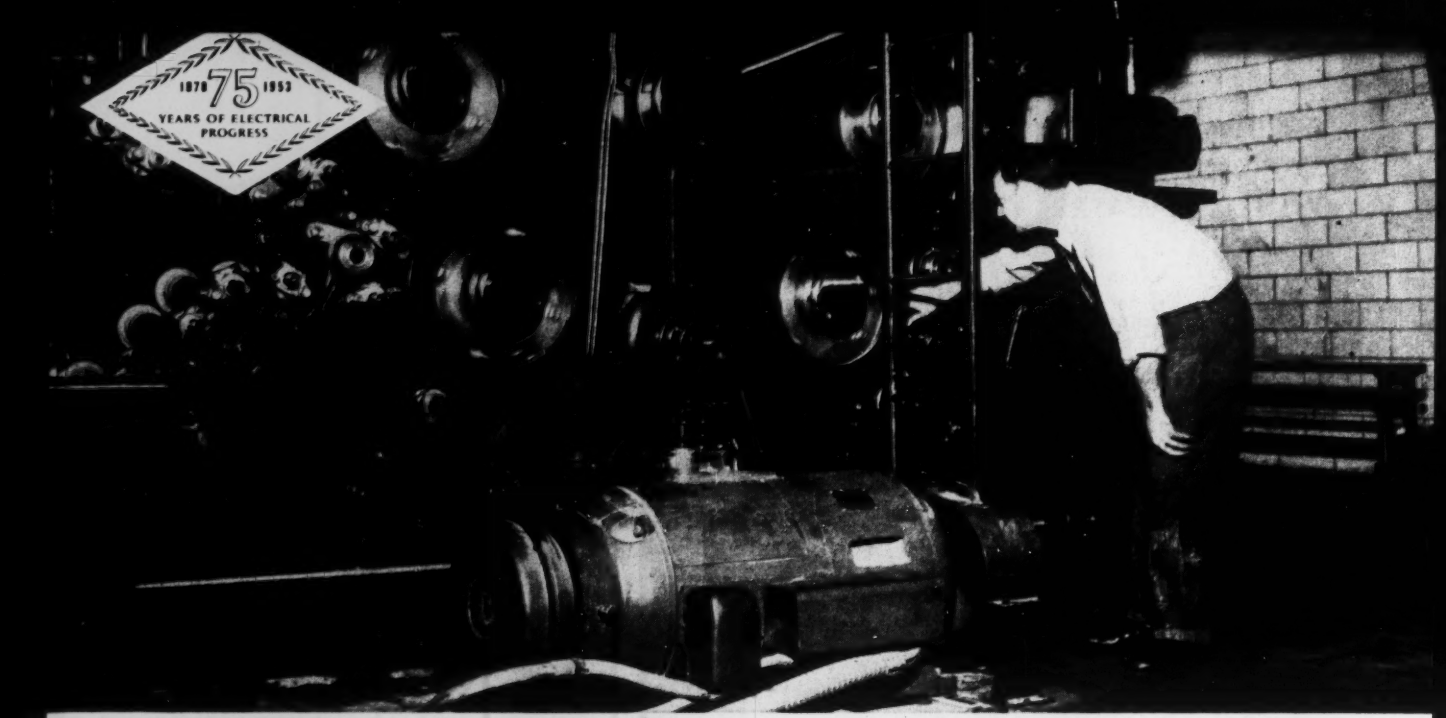
To give you prompt consultation and service, Cochrane Water Engineers are strategically located in 29 cities throughout the United States. Write today for the address of our office nearest you.

COCHRANE CORPORATION — WATER ENGINEERS FOR 90 YEARS — 1863-1953

cochrane

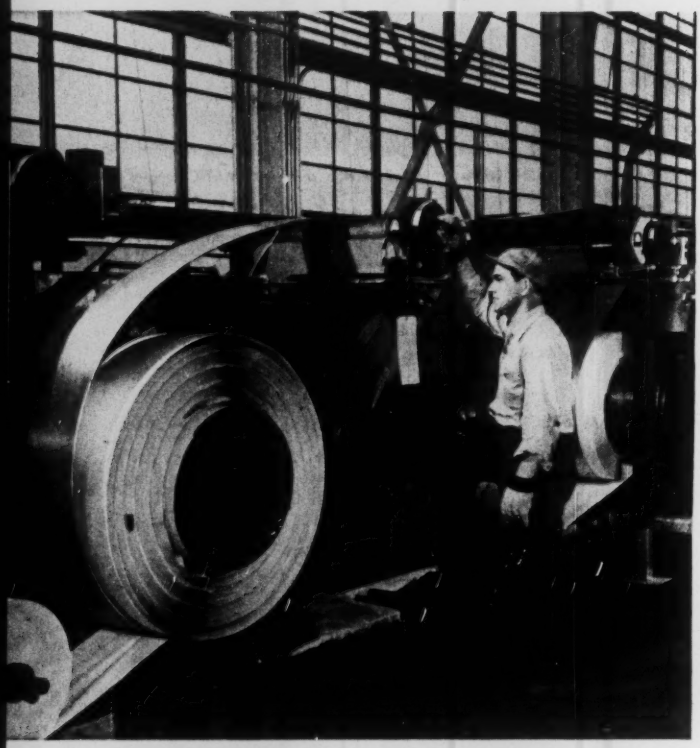
corp. 3142 N. 17TH STREET, PHILADELPHIA 32, PA.

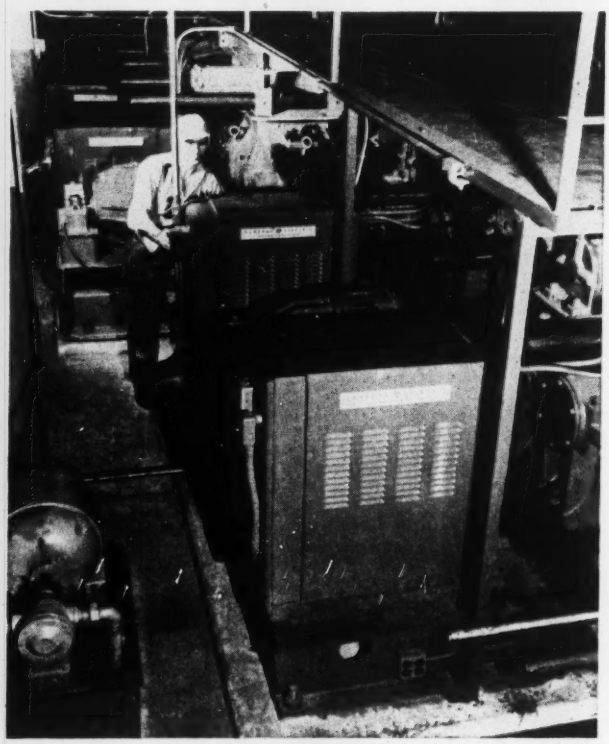
In Canada: Canadian General Electric Co., Ltd., Toronto
In Mexico: Babcock & Wilcox de Mexico, S.A., Mexico City
In Europe: Recuperation Thermique & Epuration, Paris



G-E ACA MOTOR is the main drive on this five-color press at Alford Cartons, manufacturers of folding boxes, Ridgefield Park, New Jersey. Working from AC current with no conversion equipment required, the ACA Motor is the low cost way to Adjustable-speed Drive performance. You get stepless speed adjustment within a speed range of from 3 to 1, 6 to 1, and 20 to 1.

Make your machinery more versatile





G-E SPEED VARIATOR boosts winders "spooling" chrome strip steel at Wallingford Steel Co., Wallingford, Conn.—handles all speeds from 5 to 80 feet per minute. G-E Speed Variators, with speed ranges up to 40 to 1, are complete "package" units—available in ratings from 1 to 200 hp. For even greater accuracy and versatility, these drives may include amplidyne or electronic regulators.

G-E THY-MO-TROL* DRIVE at the El-Ge Potato Chip Co., York, Pa., electronically regulates potato chip processing where accurate speed control is extremely important to the finished product. Thy-mo-trol drive is available between 1/40 and 75 hp, offers smooth speed adjustment ranging up to 100 to 1 and can be made to hold regulation as close as ±½% regardless of changes in voltage.

with a G-E Adjustable-speed Drive!

G-E ADJUSTABLE-SPEED DRIVES offer you the chance to get the most from your machinery investment. You can step up production, minimize material waste, improve product quality, and enjoy the ability to produce a greater variety of goods.

THERE IS A G-E ADJUSTABLE-SPEED DRIVE FOR YOU. Whether you need speed regulation within ±½% or ±10% you can get an economical Adjustable-speed Drive from the full G-E line. From the G-E ACA motor which requires but a simple twist of a dial . . . to the G-E Thy-mo-trol drive which permits precise electronically controlled drive speeds . . . General Electric manufactures a drive that will enable you to produce better and more uniform products. Packaged drives are available in sizes from 1/40 to 200 hp. Depending on hp, speed ranges are available from 3 to 1 up to 100 to 1.

FOR FULL INFORMATION consult your nearest General Electric Apparatus Sales Office. Your G-E Sales Representative will be glad to recommend the most economical drive best suited to your operation. For printed information on the complete line of Adjustable-speed Drives, use the coupon.

*Reg. Trademark of General Electric Company

You can put your confidence in—

GENERAL ELECTRIC

LET G.E. HELP YOU PICK THE RIGHT DRIVE

Because only General Electric makes all major types of electric adjustable-speed drives, it is best qualified to help you select the right drive. Send for these informative bulletins.

☐ **A.** This 26-page manual describes all four types of drives and where to apply them. Bulletin GEA-5334.

☐ **B.** Lower cost, simplest a-c drive. Bulletin GEA-4883.

☐ **C.** More flexibility, moderate cost. Bulletin GEA-5335.

☐ **D.** Top performance, 1/70—75 hp. Bulletin GEA-5337.

☐ **E.** Top performance, 1–200 hp. Bulletin GEA-5336.

General Electric Company
Section C646-20
Schenectady 5, N. Y.

Please send me the bulletins checked
☐ for reference only
☐ for planning an immediate project

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ADDRESS .....

CITY ..... **STATE** .....

There are hundreds of jobs open to engineers today!

but few opportunities like these

Westinghouse is in nuclear power to stay. We believe in the development of atomic energy as man's next great source of power. If you want to get in on a new era in industry, we want to talk to you.

Atomic power opportunities are waiting now for mechanical engineers with 4 to 10 years of this kind of experience...

DESIGN OR APPLICATION—light and heavy structural supports for machinery . . . high pressure piping and systems . . . rotating machinery . . . steam turbines, general steam apparatus and steam power systems . . . heat exchangers and condensers . . . hydraulic apparatus and systems, fluid flow, systems evaluations, heat balance, valve design . . . mechanical and hydraulic devices and mechanisms (thorough knowledge of properties of materials required).

LIAISON—coordination with subcontractors and customers . . . scheduling and planning of ship trials and customer testing of nuclear powered steam plants.

SUPERVISION of drafting work.

REMEMBER! We are primarily interested in good *experienced* application and development engineers—lack of previous reactor development experience *is no handicap in this type of work.*

HOW TO APPLY! What Westinghouse wants to know is: Where and when you obtained your degree . . . how you did in school . . . where you have worked at your profession . . . what kind of work you have done.

In other words, right now we're more interested in your ability to fill current openings and to develop in the Westinghouse Atomic Power Division than we are in your vital statistics. Write your letter of application accordingly.

You will be in communication with men who are experienced in keeping secrets. All negotiations will be discreet, and your reply will be kept strictly confidential.

Address your application letter to: Manager, Industrial Relations Department, Westinghouse Electric Corporation, P. O. Box 1468, Pittsburgh 30, Pennsylvania.

What do you want?

MONEY? Good jobs are open here now—waiting for good men who want to make a permanent connection.

A PERMANENT JOB? Many of the engineers who joined Westinghouse 20 and 25 years ago are still with Westinghouse—and in key positions—and engineers who join us now will have the opportunity to make this work their lifetime careers. When many other industries may be going through slack times, atomic energy will still be in a stage of expansion.

SUBURBAN LIVING? It's here—within easy driving distance of your work. Within a few minutes of shopping centers . . . schools . . . metropolitan centers.

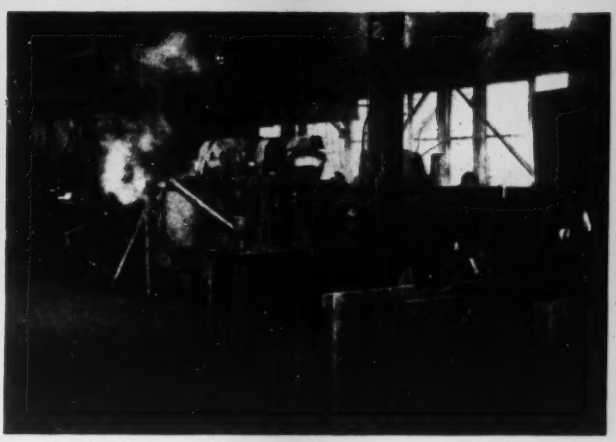
JOB EXTRAS? Westinghouse offers: Low cost life, sickness and accident insurance with hospital and surgical benefits. A *modern* pension plan. Westinghouse stock at favorable prices. Westinghouse appliances for your home at discount.

YOUR KIND OF ASSOCIATES? Every fourth person in the Division is an engineer or scientist. More than half the top Westinghouse executives are engineers.

FASCINATING WORK? What other branch of science offers such exciting challenges? So many opportunities for discovery? So many chances to benefit mankind? So many opportunities for original work?

GROWTH OPPORTUNITIES? Never again in your lifetime will you be able to get into such a sure-to-expand industry so early in its development.

YOU CAN BE SURE.. IF IT'S Westinghouse



OILGEAR DRIVES ON GLAMORGAN CENTRIFUGAL PIPE CASTING MACHINE

Something more than 5 years ago, the Glamorgan Pipe & Foundry Company, of Lynchburg, Va., a leading manufacturer of cast iron pipe, designed its own centrifugal pipe casting machine, using Oilgear Fluid Power equipment to tilt the ladle and move the casting carriage.

The degree of control over pouring rate and carriage travel afforded by Oilgear has had almost unbelievable results. Scrap caused by irregularities in moving parts has become negligible. Weight controls are well within the close limits set by Industry specifications. Only 3 men are needed to operate the equipment. Despite the fact the machine has averaged 500 operations per day since 1948, maintenance on Oilgear equipment has totaled less than $200.00. The fumes and dirt necessarily present in foundry operations have had no effect on Oilgear fluid power equipment.

TYPICAL OF OILGEAR'S ABILITY TO SOLVE MACHINE DESIGN PROBLEMS

Sure it takes power to tilt a ladle and move a pipe casting machine carriage. But above all, it takes absolute and precise control of the speed of pouring and the speed of carriage travel if the product is to be perfect and uniform.

It not only takes power but power under control to print in register on flimsy cellophane at high speed, to set up paper piles for repetitive serial cuts to hairline register automatically, to cut fish on a continuous conveyor to accurate weight for canning, to vary the speed of a large beater automatically to conform sensitively to the changing viscosity of the mass.

These are all triumphs of Oilgear Fluid Power—where this flexible, controllable, versatile power leads the way to better machine design or to the solution of hitherto unsolved problems.

Think of Oilgear Fluid Power as identical with electrical power . . . generated by a pump . . . applied over conductors through a motor or motor element. But Oilgear Fluid Power can be converted into linear movement as well as rotary; can be exerted statically, without motion; can be varied infinitely, steplessly without additional equipment.

And the unique Oilgear design is oil hydraulic design at its simplest and best. It is generally accepted as the leader in its field. It will cost you nothing to see what Oilgear can do to improve the salability of your equipment . . . may profit you and your users in an amazing degree. THE OILGEAR COMPANY, 1570 W. Pierce St., Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

Circulating conditioned air evenly throughout the smokehouse is a problem.

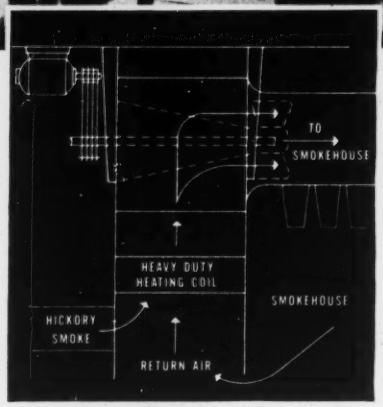
HOW TO "SMOKE OUT" HIGH OPERATING COSTS IN A SMOKEHOUSE

The circulation of conditioned air, so necessary for smoking meats, has always been a problem. Tars accumulating on the fans and heating coils cut capacity, thus slowing down production. The necessary maintenance further increases operating costs, but not any more.

Armour and Company knew they needed a fan that would keep belts and bearings outside of the air stream. The housing had to be so shaped that it would not collect tars. The steam heating coil had to be sturdy, easily cleanable, and efficient.

Engineers of Armour and Westinghouse teamed up—decided on Westinghouse Elbow Axiflo® Fans and Heavy Duty Steam Coils built entirely of steel. This was the answer to this involved problem. The fans and coils fill the bill so well that they have now been put into service at 16 Armour smokehouses.

Some day you may have a problem that involves *putting air to work*. When you do, remember that Westinghouse has the most complete line of air handling, air cleaning and air conditioning in the industry. Ask for new Catalog 600. It contains 60 fact-filled pages on these products, and how they can put air to work for you. For your free copy, call your local Westinghouse-Sturtevant office. Or, write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.



HOW A SMOKEHOUSE IS "SMOKED"

Hardwood smoke is drawn into the system and mixed with return air from the smokehouse. This mixture next passes over a heating coil to bring it to the proper temperature. An Elbow Axiflo Fan then turns it 90° into ducts which feed the discharge nozzles.

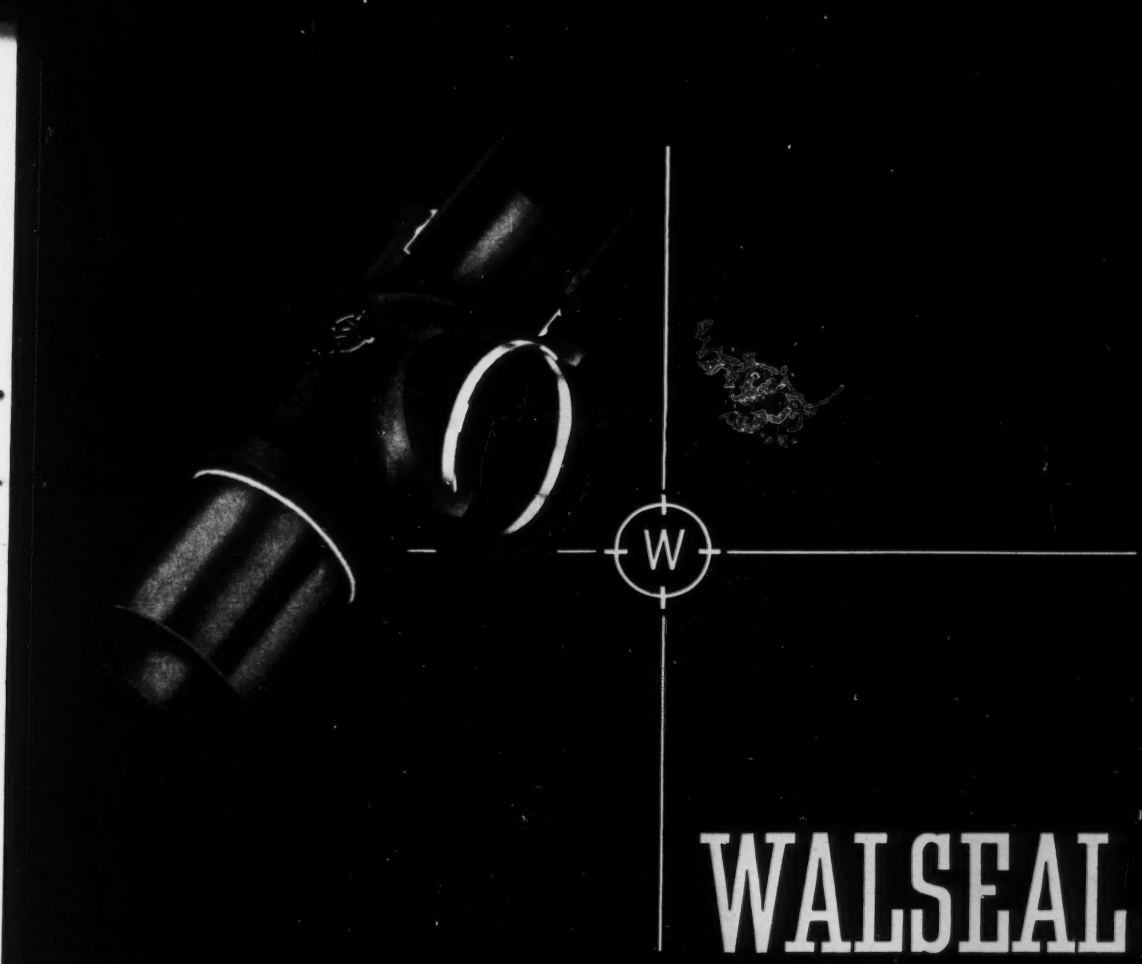
Note how fan motor, bearings and belts lie outside the air stream. This keeps them free of hazardous tar and heat, and makes them easy to maintain. The fan and coils are accessible, and all-steel construction withstands alkali cleaners.

YOU CAN BE SURE...IF IT'S

Westinghouse

AIR HANDLING

J-80284

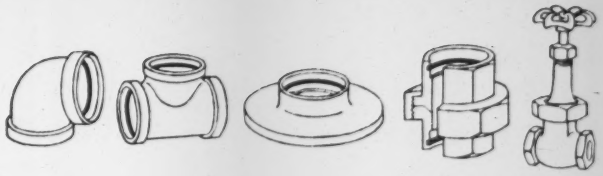


WALSEAL®

COMPLETE LINES OF WALSEAL VALVES AND FITTINGS

WALSEAL is a smooth-bore, bronze valve or pipe fitting having a **factory-inserted** ring of silver brazing alloy in the outlet or outlets. The brazed joint that results when a Walseal product is installed is leakproof, vibration-proof, and corrosion resistant. The alloy fillet that appears upon completion of the joint is visual assurance of **full penetration of alloy.** This improved method of joining brass, copper, or copper-nickel pipe or tube is another Walworth contribution to the progress of the valve and fittings industries.

In addition to its complete line of Walseal products, the Walworth Company manufactures complete lines of valves, fittings, unions, and flanges in a wide range of sizes and temperature-pressure ratings. The company also makes three lines of pipe wrenches, the Genuine Stillson, Walco, and Parmelee. Walworth products total approximately 50,000 items and are sold through distributors or agents in all parts of the world.



The sectioned Walseal tee illustrated, shows: (a) the fillet of alloy that appears upon completion of the Walseal joint. This fillet is your visual assurance of complete penetration. (b) the factory-inserted ring of silver brazing alloy. (c) sectioned view of the completed Walseal joint showing penetration of alloy both ways from the insert. Walseal joints can be made only with Walseal valves or fittings. For further details regarding Walseal products, ask for Circular 84.

WALWORTH

Manufacturers since 1842

valves . . . fittings . . . pipe wrenches

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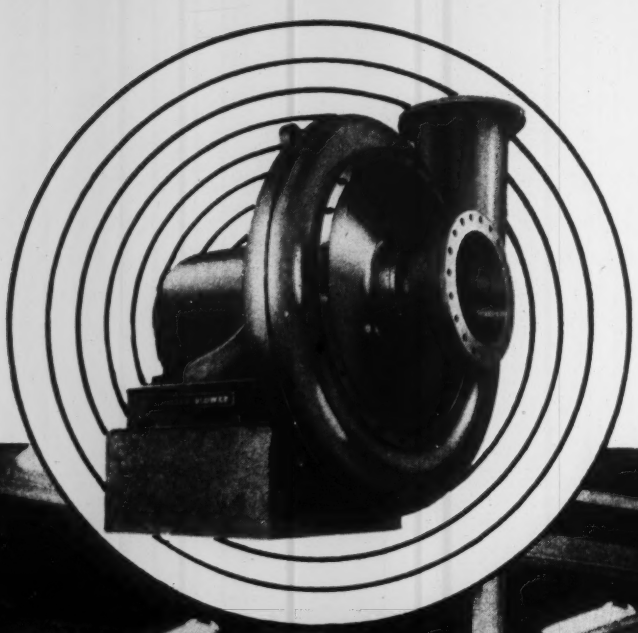
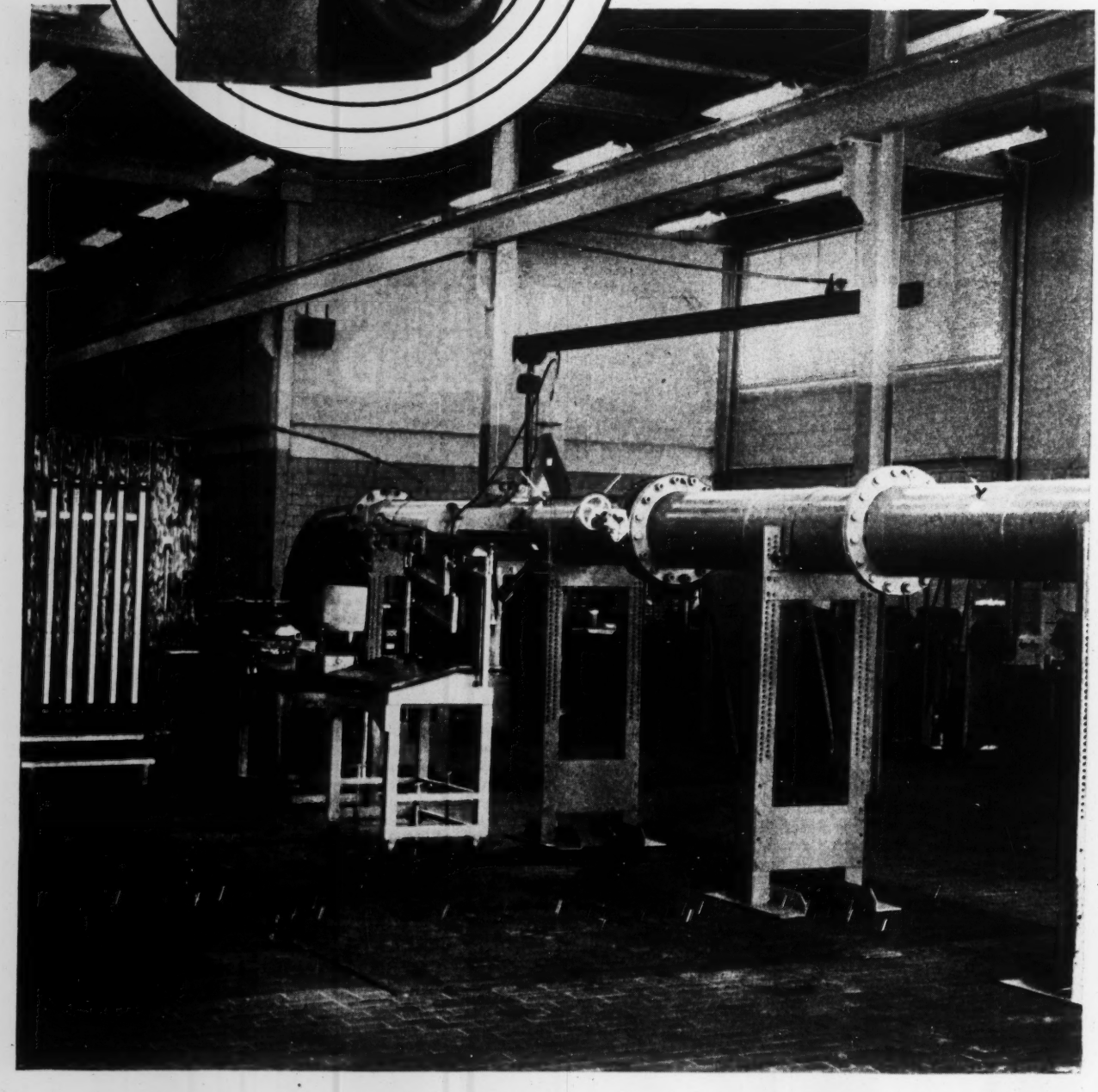


CENTRI

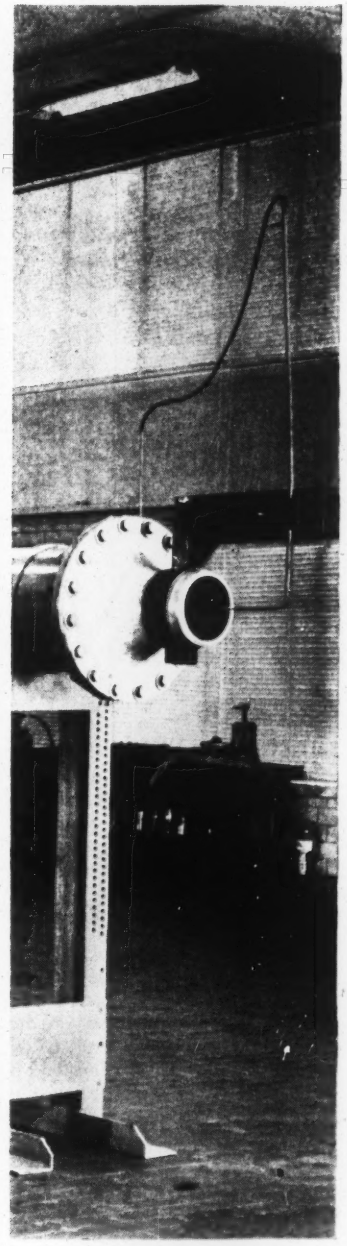
built and



AMERICAN BLOWER

FUGAL COMPRESSORS

backed by a great name in air handling



When you select American Blower Single Stage Centrifugal Compressors for your jobs, you get superior quality and workmanship.

Prior to shipment, each compressor is thoroughly tested for mechanical and performance characteristics in accordance with the A. S. M. E. Power Test Code for Centrifugal Compressors and Exhausters.

The photograph at left shows part of the extensive and intricate testing equipment used in American Blower's modern research laboratory.

American Blower Single Stage Compressors are available in sizes from 30 to 600 HP, pressures from 1¼ to 3¾ lbs. They're compact and are adaptable to all types of drives.

For technical data, consult the nearest American Blower Branch Office or write us for Bulletin 109.

Whether you need equipment for heating, cooling, ventilating, air conditioning, vapor absorption, fume removal, dust collecting, mechanical draft, heat transfer or smooth power transmission thru Gyrol Fluid Drives — American Blower manufactures a complete line of products to meet your requirements. Helpful technical literature is available on each product. Branch offices, staffed with trained sales engineers, are conveniently located in all principal cities.

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Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

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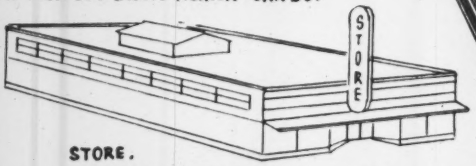
NOTES FROM AN ENGINEER'S SKETCH PAD

LOOKS LIKE THAT VERSATILE DRAVO "COUNTERFLO" HEATER CAN BE USED ON PRACTICALLY ALL OUR JOBS.

SCHOOL DISTRICT BUDGET LIMITED. CAN SAVE WITH DRAVO HEATERS.

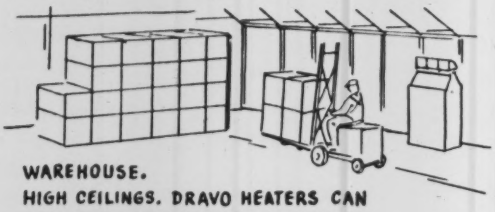
CHURCH. INTERMITTENT HEATING. NEEDS QUICK PICK-UP. DRAVO HEATER CAN DO.

ARMY BASE.
WINTER CONSTRUCTION ON THESE BARRACKS. CAN INSTALL DRAVO HEATERS EARLY FOR HEAT DURING CONSTRUCTION AND AFTER COMPLETION.

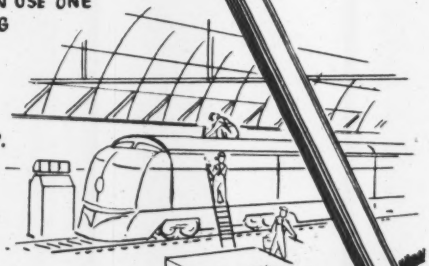


STORE.
WITH DRAVO HEATERS, CAN USE ONE SET OF DUCTS FOR HEATING AND AIR-CONDITIONING.

INDUSTRIAL PLANT.
DRAVO HEATERS HAVE 150' AIR THROW. NO DUCTS NEEDED.

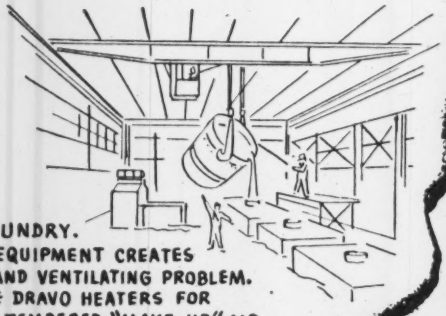


WAREHOUSE.
HIGH CEILINGS. DRAVO HEATERS CAN REDUCE ROOF HEAT LOSS, KEEP HEAT WHERE IT'S NEEDED.

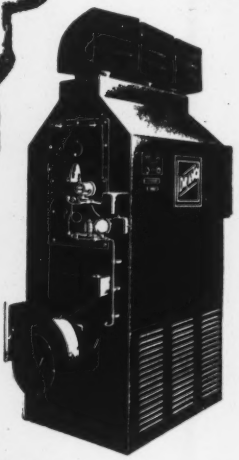


DIESEL RAILROAD SHOP.
NEEDS HEAT AT WORKING LEVEL.
DRAVO HEATERS IDEAL.

PROCESS INDUSTRY.
CURING AND DRYING.
SPECIFY DRAVO HERE.



FOUNDRY.
EXHAUST EQUIPMENT CREATES HEATING AND VENTILATING PROBLEM.
USE DRAVO HEATERS FOR TEMPERED "MAKE-UP" AIR.



...kin
...w Dravo.

A case study on any ... installations is yours for the asking. For complete information on how Dravo "Counterflo" Heaters can help solve your heating problems, write for Bulletin N-52.

DRAVO CORPORATION

HEATING DEPARTMENT, DRAVO BUILDING, PITTSBURGH 22, PA.

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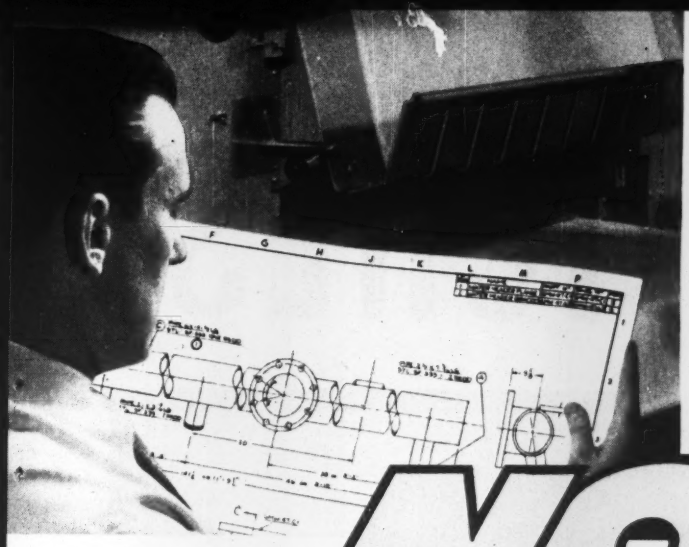

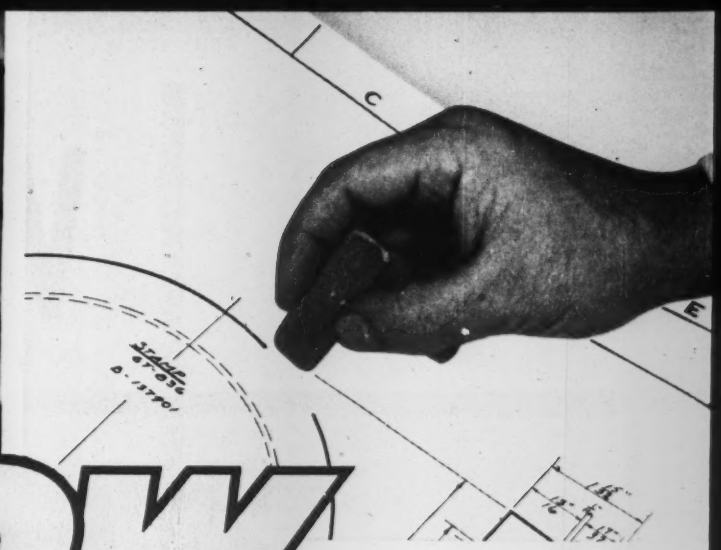

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more translucent than before Today's Kodagraph Reproduction Cloths have a new, highly translucent base—*an important new plus in drawing reproduction!* For now you can turn out blueprints and direct-process prints at faster speeds . . . save time and money. And famous Kodak research and production know-how brings you this increased translucency without compromise—your Kodagraph Cloth intermediates will be as durable and long-lasting as ever.

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***1. Kodagraph Autopositive Cloth*—** for use in blueprint and direct-process machines . . . and vacuum frames. Positive photographic intermediates are produced directly from the original drawings—without a negative step or darkroom handling.

***2. Kodagraph Contact Cloth*—** for use in low-intensity contact printers. Conventional negative-positive printing characteristics . . . darkroom handling. Especially recommended when your negatives require considerable opaquing or other hand work.

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Write today for a free copy of "Modern Drawing and Document Reproduction." Detailed facts on improved Kodagraph Reproduction Cloths . . . and the complete line of Kodagraph Reproduction Materials which you, or your local blueprinter, can process *conveniently, economically.*

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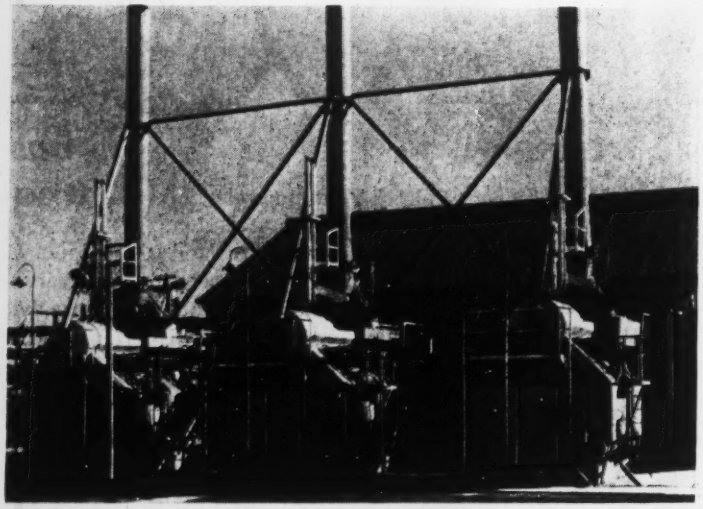
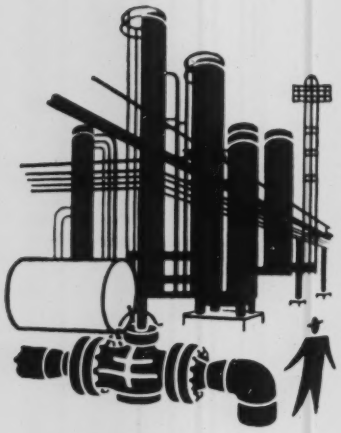
WICKES*



*WICKES steam generators are cutting costs in America's finest refineries and natural gasoline plants



Recognized Quality Since 1854

Wickes Type A Steam Generators have a splendid record in the oil processing industry. In scores of refineries and natural gasoline plants they have helped speed production and reduce operating costs considerably. They operate at a high degree of efficiency and maintenance costs are unusually low. Wickes can fill your requirements for all types of multiple drum boilers up to 250,000 lbs. steam per hour at 1000 psi. — adaptable to any standard method of firing. Units capable of sustained steam production up to 35,000 lbs. per hour at 1000 psi. can be shop-assembled for immediate installation. Write today for descriptive literature or consult your nearest Wickes representative.

THE WICKES BOILER CO.

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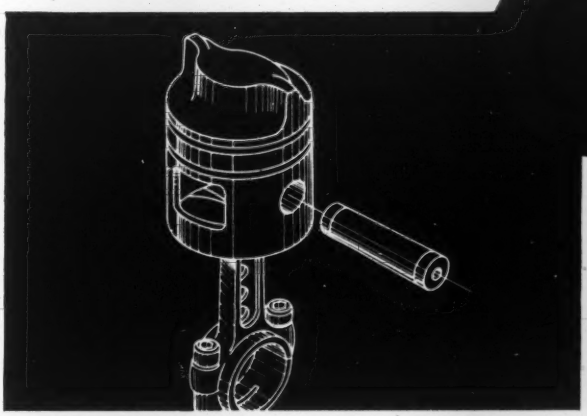
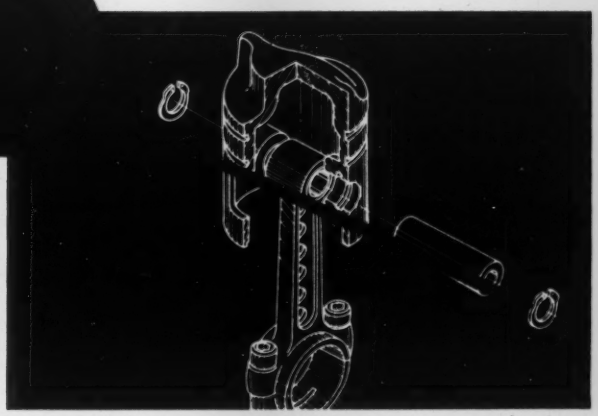
144

2 Waldes Truarc Rings Replace 2 End Plugs ...Eliminate 3 Operations...Save $.066 Per Unit



OLD WAY Two inserted-plug type wrist pin locks hold wrist pin in place. 3 operations involved: costly machining, pressing in place, post-assembly machining. Costly maintenance problem—resulting from end plugs hammering loose.



TRUARC WAY Two Truarc Inverted Retaining Rings (Series 5008) hold wrist pin in place. Truarc Rings snap into grooves easily cut in piston, provide positive lock . . . practically eliminate maintenance costs. Quick assembly, disassembly.

Titan Chain Saws, Inc., Seattle, Washington, uses 2 Waldes Truarc Rings to replace old-style inserted-plug type wrist pin locks in their Titan chain saws. Use of Waldes Truarc Retaining Rings eliminates 2 press fit end plugs. Machining of plugs, pressing in place, finish machining—no longer required. Truarc way holds rejections to a minimum. Unit efficiency is greatly increased.

Redesign with Truarc Rings and you, too, will cut costs. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better job of holding parts together.

Waldes Truarc Rings are precision-engineered . . . quick and easy to assemble and disassemble. Always circular to give a never-failing grip. They can be used over and over again.

Find out what Waldes Truarc Retaining Rings can do for you. Send your blueprints to Waldes Truarc engineers for individual attention, without obligation.

USE OF 2 WALDES TRUARC RINGS PERMITTED THESE SAVINGS PER UNIT:

OLD WAY	
Cost of 2 end plugs Cost of pressing in and machining	$ .169
TRUARC WAY	
Cost of grooving piston Cost of 2 Truarc Rings	.103
Saving per Unit	**$ .066**

For precision internal grooving and undercutting... Waldes Truarc Internal Grooving Tool.

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WALDES

TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,848; 2,455,165; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING.

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.

Please send me the new Waldes Truarc Retaining Ring catalog. ME 015

(Please print)

Name .....

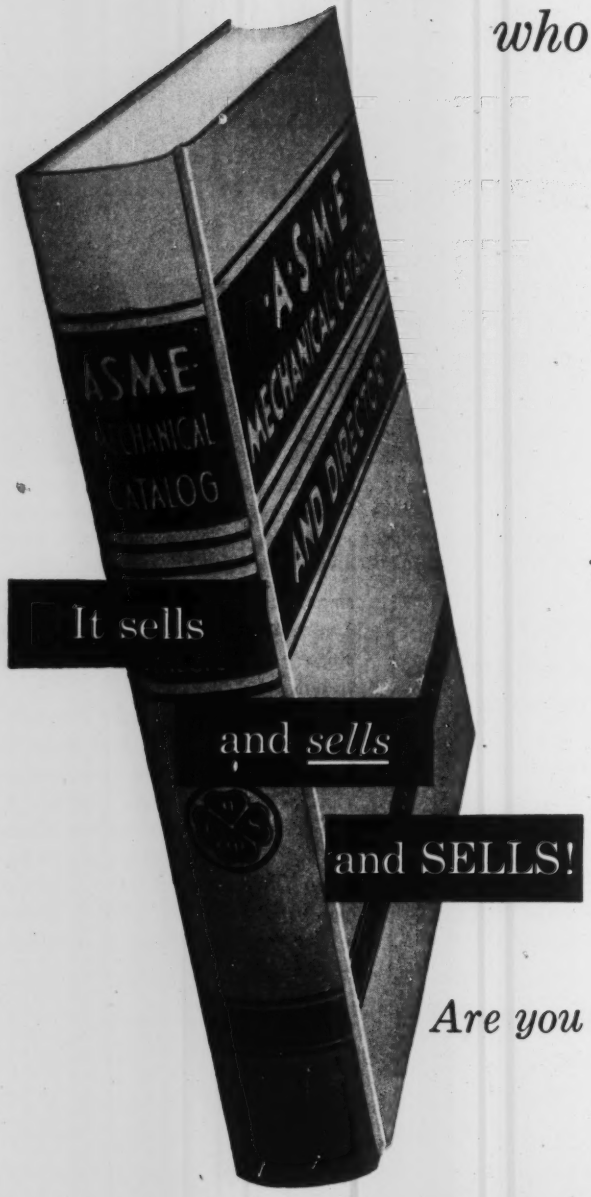
Title .....

Company .....

Business Address .....

City ..... Zone ..... State .....

No one understands the selling power of the ASME MECHANICAL CATALOG *and Directory like the engineers who buy from it.*



That's why so many, who first used the Catalog for selecting and specifying products they wanted to buy, now use it for advertising products they want to sell.

For more than 40 years the ASME Catalog has taken its place as the No. 1 *market place in print* for the mechanical industries. Tens of millions of dollars of products and services that will be bought in the year beginning next October will be chosen directly from the

ASME MECHANICAL CATALOG

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A-S-M-E MECHANICAL CATALOG and Directory

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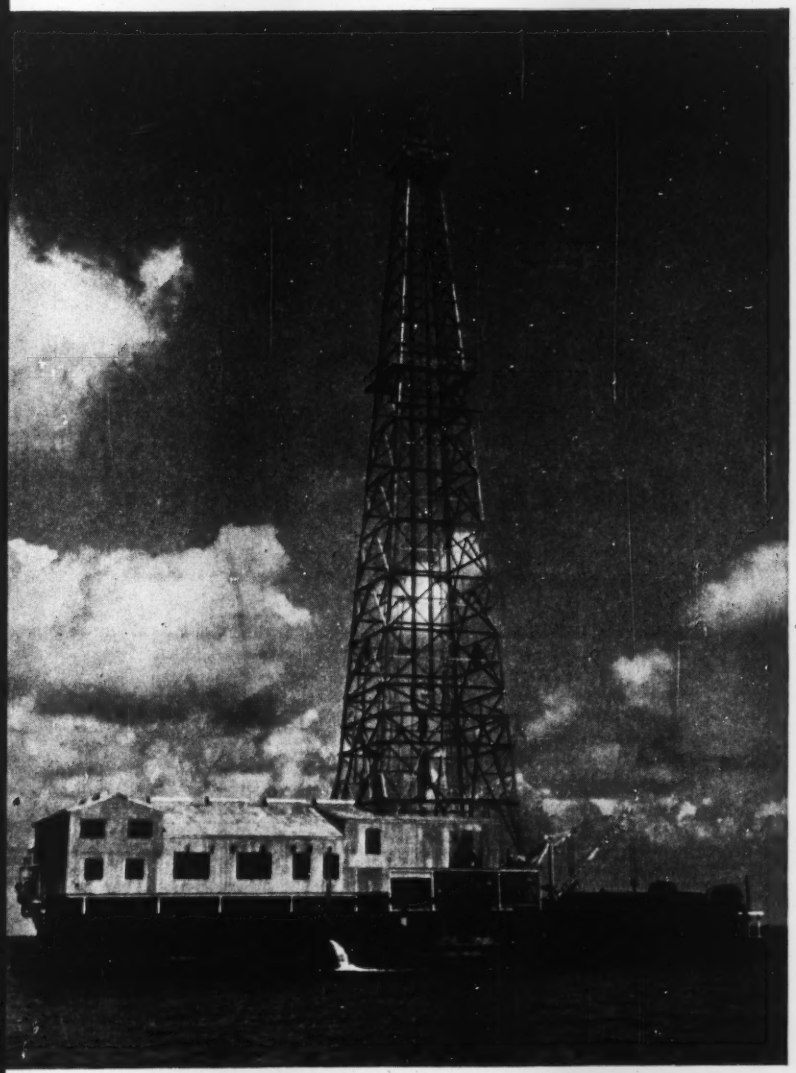
Link-Belt Research and Engineering . . . Working for Industry

Under water or through 20,000 feet of rock... tough drilling calls for LINK-BELT chain drives



For 50 years LINK-BELT has helped oil field operators maintain production schedules

OIL is where you find it. And whatever the location, production schedules must be maintained. That's why so many high-power drilling rigs and pumping units—particularly at isolated sites—are driven with Link-Belt chain. The high-speed, heavy-load capacity of these long-life drives meets every requirement for rugged oil field service.

In addition, experienced operators rely on many other Link-Belt products to cut drilling, producing and refining costs. Link-Belt Shale Shakers assure "clean" mud required for drilling. Link-Belt ball and roller bearings, enclosed gear drives and flexible couplings—all provide efficient power transmission under the toughest service conditions.

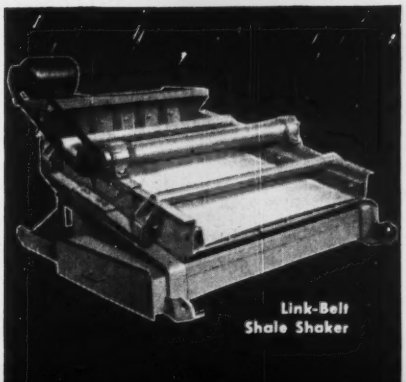
It's the same story in industry after industry—Link-Belt research and engineering are making valuable contributions to increased production, lower costs. Wherever wheels turn or materials move, you'll find Link-Belt conveying, processing and power transmission machinery at work—providing efficient, mechanized service.

On the largest power rig afloat (top), Link-Belt Precision Steel Roller Chain minimizes costly shutdowns. This and other Link-Belt products (bottom left) are widely used as components throughout the oil fields. Link-Belt Shale Shaker (bottom right) assures a continuous supply of "clean" mud, free of foreign material. 13,005

SS-40 Hyper oil drilling chain

Precision steel roller chain

Ball and roller bearings



Link-Belt Shale Shaker

LINK-BELT

LINK-BELT COMPANY

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Keep Heat Transfer Surfaces CLEAN...

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SCRAPED SURFACE *Exchangers*

IF you are all "gummed up" with a tough heat transfer problem, Vogt Scraped Surface Exchangers will provide the answer. They have patented scraper elements which prevent fouling of the heat transfer surfaces and insure the highest rate of heat exchange between the product and the cooling or heating medium. The scrapers also continuously agitate the fluid and assist removal of solids from the unit.

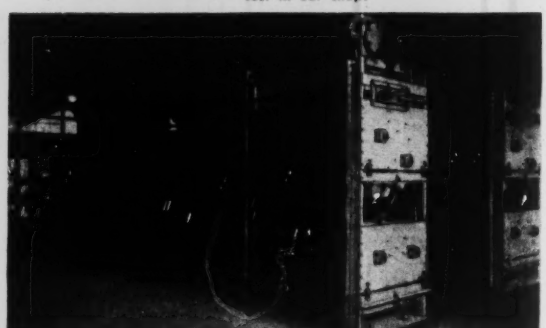
DOUBLE PIPE EQUIPMENT is available in two types; EXCHANGERS, for cooling with water, brine, and cold filtrate, and for heating with steam or hot liquids; and CHILLERS, for use with volatile refrigerants such as ammonia, propane, and Freon. Both types have 8" jacket pipes and 6" inner pipes with scrapers.

SHELL AND PIPE TYPE UNITS are designed for use with volatile refrigerants and for heating fluids with steam or similar heating mediums. They consist of large welded shells each containing seven 6" scraped pipe sections.

Vogt Scraped Surface Exchangers serve profitably as oil chillers, crystallizers, and heaters in many processes in the petroleum and chemical industries. Their application to your heat transfer problems will receive the prompt attention of our Engineering staff.

Write for Bulletin PE-1

*DOUBLE PIPE UNIT. Drive end close-up of 12 section unit under test in our shop.



*SHELL and PIPE UNITS. Two of five units installed in a leading petroleum refinery.

*Patented

HENRY VOGT MACHINE CO.

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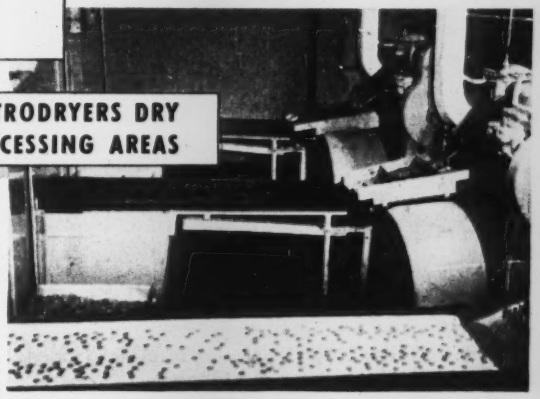
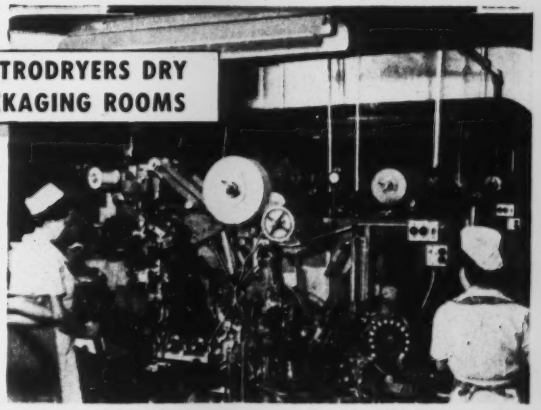
Why let WETth in . . . when you have to take it out

LECTRODRYERS DRY STOREROOMS



LECTRODRYERS DRY PROCESSING AREAS



LECTRODRYERS DRY PACKAGING ROOMS

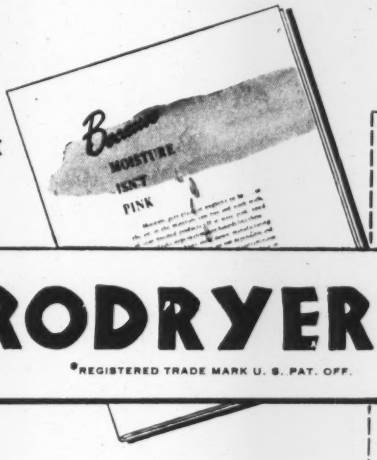
WETth—moisture you can't see or feel—bucks production schedules from every angle. Here's how:

Air in storerooms is loaded with moisture. Raw materials soak it up; finished products deteriorate rapidly under its influence. Lectrodryers* remove that moisture, safeguarding your products and saving you money by making it unnecessary to employ other protective measures.

Unwanted moisture in manufacturing areas slows down and stalls production—causes fingermarking and corrosion of highly polished metal surfaces—breaks down electrical insulation. Lectrodryers hold humidities at uniformly low levels, letting work proceed at a fast clip, regardless of outside weather conditions.

Are you wondering what WETth is doing to your production? Mail the coupon today for evidence of how other manufacturers are using Lectrodryers to eliminate their troubles with unwanted moisture.

MAIL THE COUPON FOR THIS FREE BOOK



LECTRODRYER

*REGISTERED TRADE MARK U. S. PAT. OFF.

Pittsburgh Lectrodryer Corporation
335 32nd Street, Pittsburgh 30, Pa.

Send "Because Moisture Isn't Pink" to

Name_____

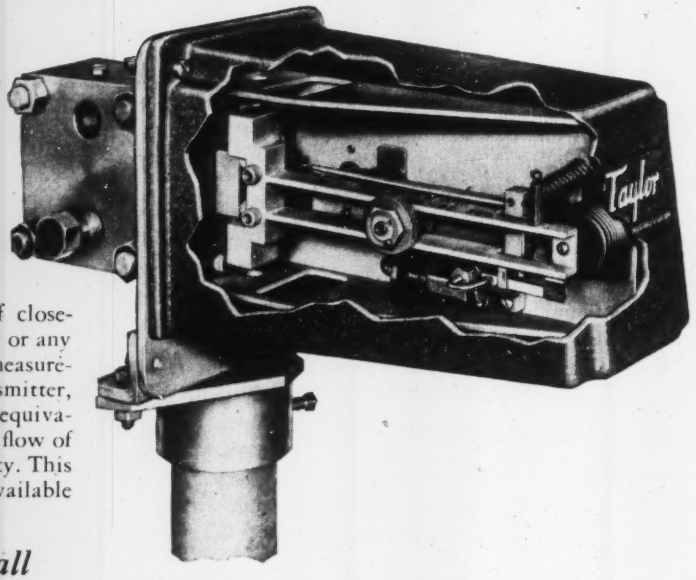
Title_____

Company_____

Address_____

Taylor announces SIMPLIFIED FLOW MEASUREMENT

—with the NEW Taylor TRANSAIRE® Differential Pressure Transmitter!



HERE'S Taylor's answer to the problem of close-coupled fluid flow measurement, liquid level or any other installation requiring differential pressure measurement and transmission. It is a force-balance transmitter, designed to convert differential pressure into an equivalent 3 to 15 psi output. It can be used to measure flow of liquid, steam or gas; liquid level or specific gravity. This Transmitter has a 1500 psi pressure rating and is available in any desired range, from 20" to 800" of water.

Inexpensive and Simple to Install

1. Simplified piping because it can be close-coupled to orifice flanges.
2. No Leveling—mercuryless dry meter.
3. Side, top or bottom bracket mounting available with 2" pipe stand.
4. No seal pots required—Negligible displacement because of force-balance construction.
5. Light weight for easy handling; weighs only 23 lbs.
6. Vent screws for simple, solid filling.

Enonomical—Easy to Maintain

7. Self draining or venting—no periodic manual venting or draining.
8. Mercuryless—flexible but tough Teflon coated glass fabric diaphragm.
9. Over-range to full body rating with no permanent damage.
10. Purges, if required, can be installed to keep body swept clean.
11. Simple range change by sliding pivot—screw driver trim.

Accurate

12. Relay valve for linearity, minimum hysteresis, fast speed of response.
13. Pressure effect 0.2% / 100 psi.
14. Temperature effect 1.0% / 100°F.
15. Self draining and venting. No errors build up during operation.
16. Damped pneumatic circuit—stable air output even on vibrating pipe lines.

Rugged and Dependable

17. Body forged steel or type 430 Stainless Steel. Working pressure rating, 1500 psi.
18. Weather-proof housing built for tough service and outdoor mounting.
19. Force-balance construction—negligible motion—minimum possible wear.
20. Process sealing bellows 3-ply type 316 stainless steel.

Adaptable

21. 100% suppression—continuously adjustable from 0 to 100%. Ideal for liquid level applications.
22. Ten-to-one rangeability in each of 2 forms: a. 20-200" water, b. 80-800" water.

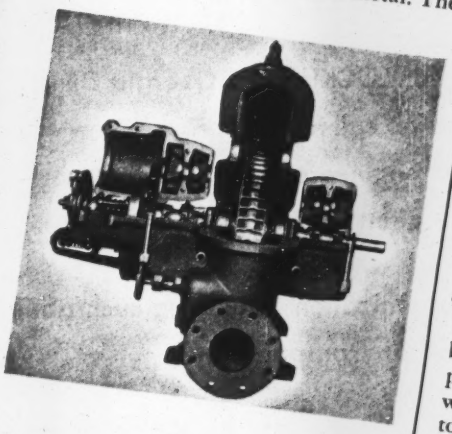
Find out more about this latest addition to Taylor's three-part TRANSET* System. Ask your Taylor Field Engineer, or write for **Bulletin No. 98226.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

TERRY

The rotor of a Terry Solid-wheel Turbine is a single forging of special composition steel. It is first rough turned in two operations, as illustrated, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or work out.*



As the only function of the blades is to form a series of pockets, wear of the blades is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

It is impossible for the blades to foul. They have large clearances, and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry Solid-wheel Turbine is an extremely reliable piece of equipment. Why not write for complete details today?

THE TERRY STEAM TURBINE CO.
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Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

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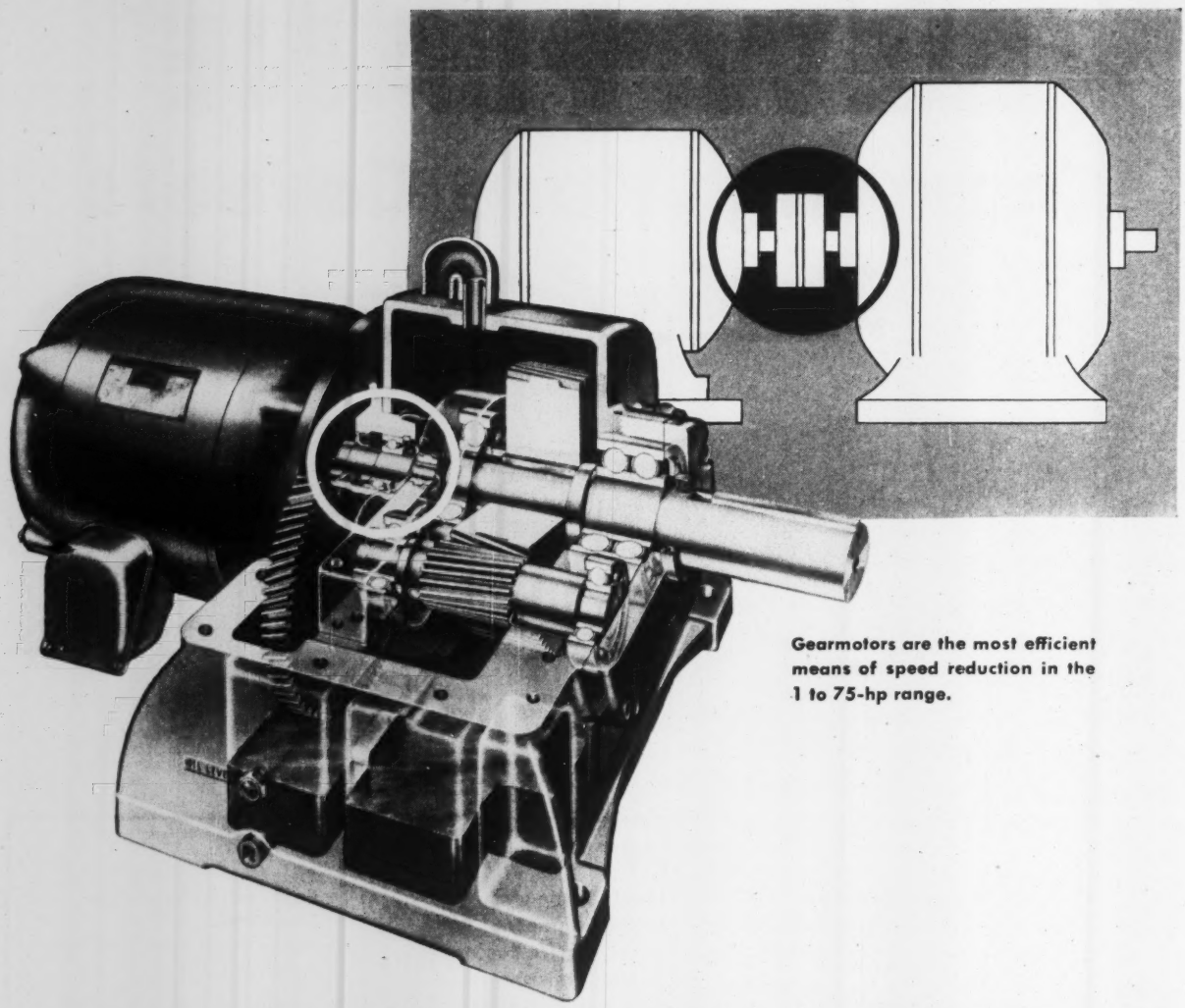

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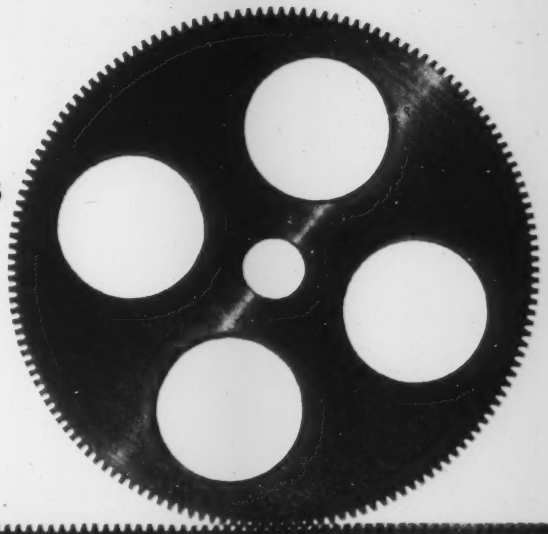
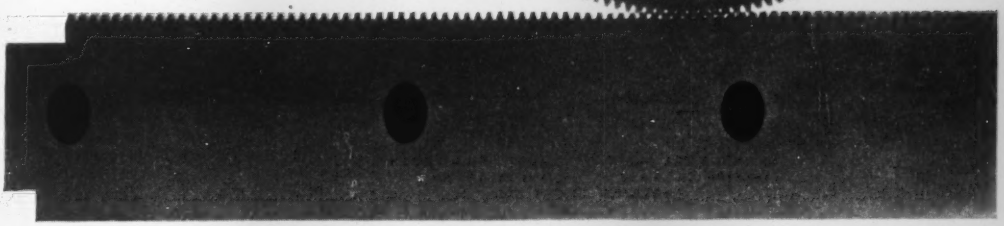
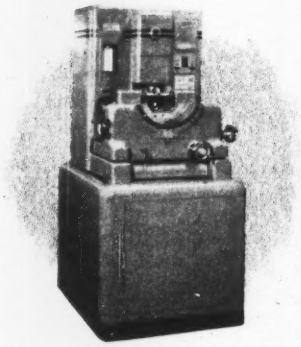
Westinghouse

Here's *Why* you can check precision gears *more conclusively* with Kodak Conju-Gage Gear Checkers







The Kodak Conju-Gage Gear Checker automatically records the composite effects of runout, base pitch error, tooth thickness variations, profile error, lead error, and lateral runout. Illustrated is the Kodak Conju-Gage Gear Checker, Model 4U, for gears up to 4⅛" pitch diameter. Larger and smaller models are also available.

Why the composite check

Errors in gears seldom occur individually—they're usually combinations of as many as six types of errors. The practical way to test gears for these errors is to test them in action through the composite check recommended in the new American Standard (AGMA 236.02; ASA B6.11-1951).

This check measures gear errors as variations in center distance when the gear is rotated in contact with a master of known accuracy. Since this variation is the sum of errors in both gear and master, the degree of precision measurable depends on the precision of the master.

Why the Conju-Gage Gear Checker

Kodak Conju-Gage Gear Checkers use a master of exceptional accuracy, the Kodak Conju-Gage Worm Section. These Worm Sections are generated by the continuous action of a thread grinder under control of a precision lead screw—circular pitch error and tooth thickness variations cannot be introduced by defects in an intermittent indexing mechanism. This means a more accurate gaging element, less chance that error in the master may coincide with a tolerable error in the gear to result in a needless rejection. Less chance, too, that an error in the master may subtract from an intolerable error in the gear, passing a gear that will fail in use.

By passing each right gear, rejecting each wrong gear, the Kodak Conju-Gage Gear Checker helps you reduce costs while maintaining highest precision. For the full story of this and other economies achieved by Conju-Gage instrumentation, send for the booklet, "Kodak Conju-Gage Gear Testing Principle." Eastman Kodak Company, Industrial Optical Sales Division, Rochester 4, N. Y.

CONJU-GAGE INSTRUMENTATION

. . . a new way to check gear precision in action

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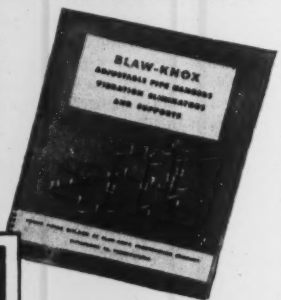

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December, 1952 CARD INDEX Vol. 74, No. 12

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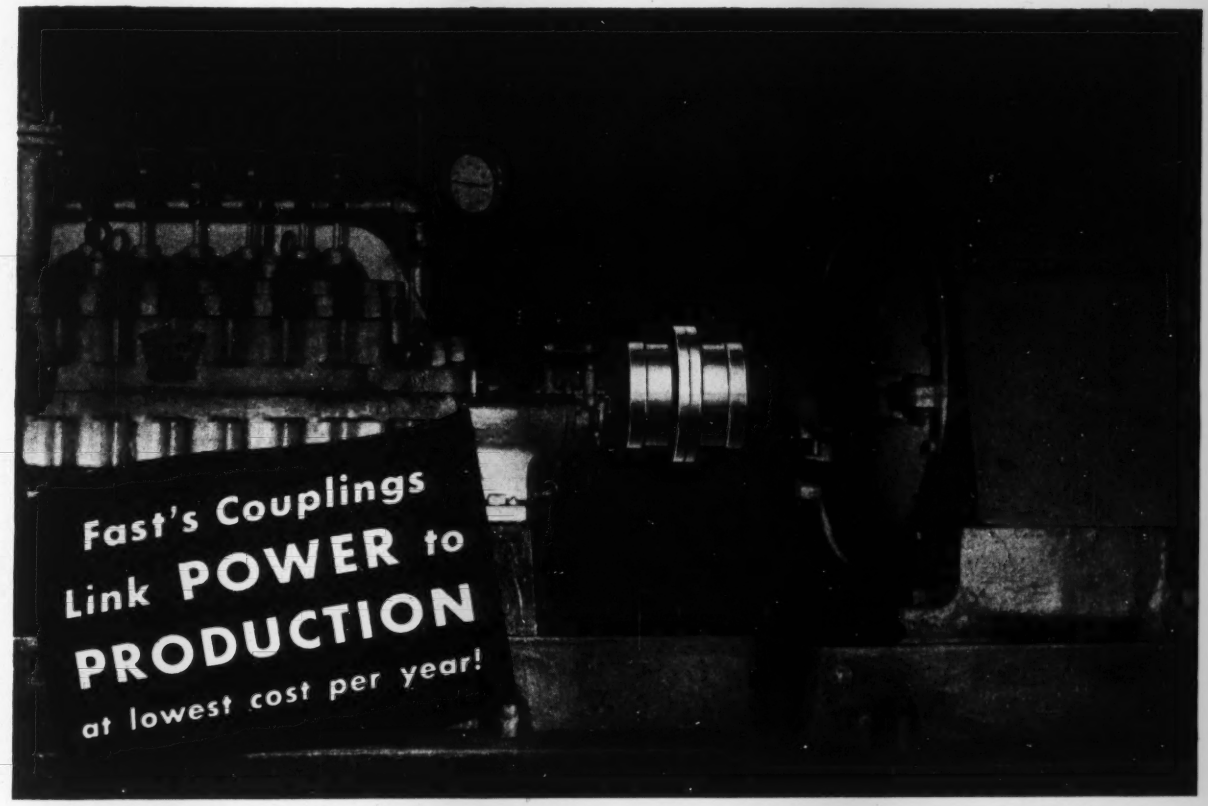

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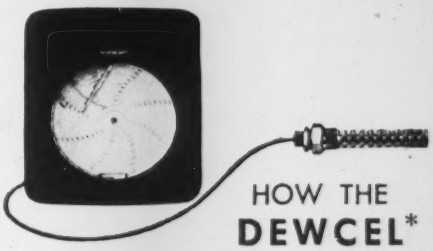

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The Dewcel element is a thermometer bulb (liquid-filled or electric-resistance type) jacketed with lithium-chloride-impregnated woven glass tape. Over this are wound two spaced gold or silver wires connected to an AC source. The lithium chloride absorbs moisture, allowing current to flow, generating heat, and raising the temperature. Equilibrium temperature is reached when vapor-pressure of the moist salt exactly balances that of the surrounding air or gas. The System translates this temperature into direct readings of dew point.

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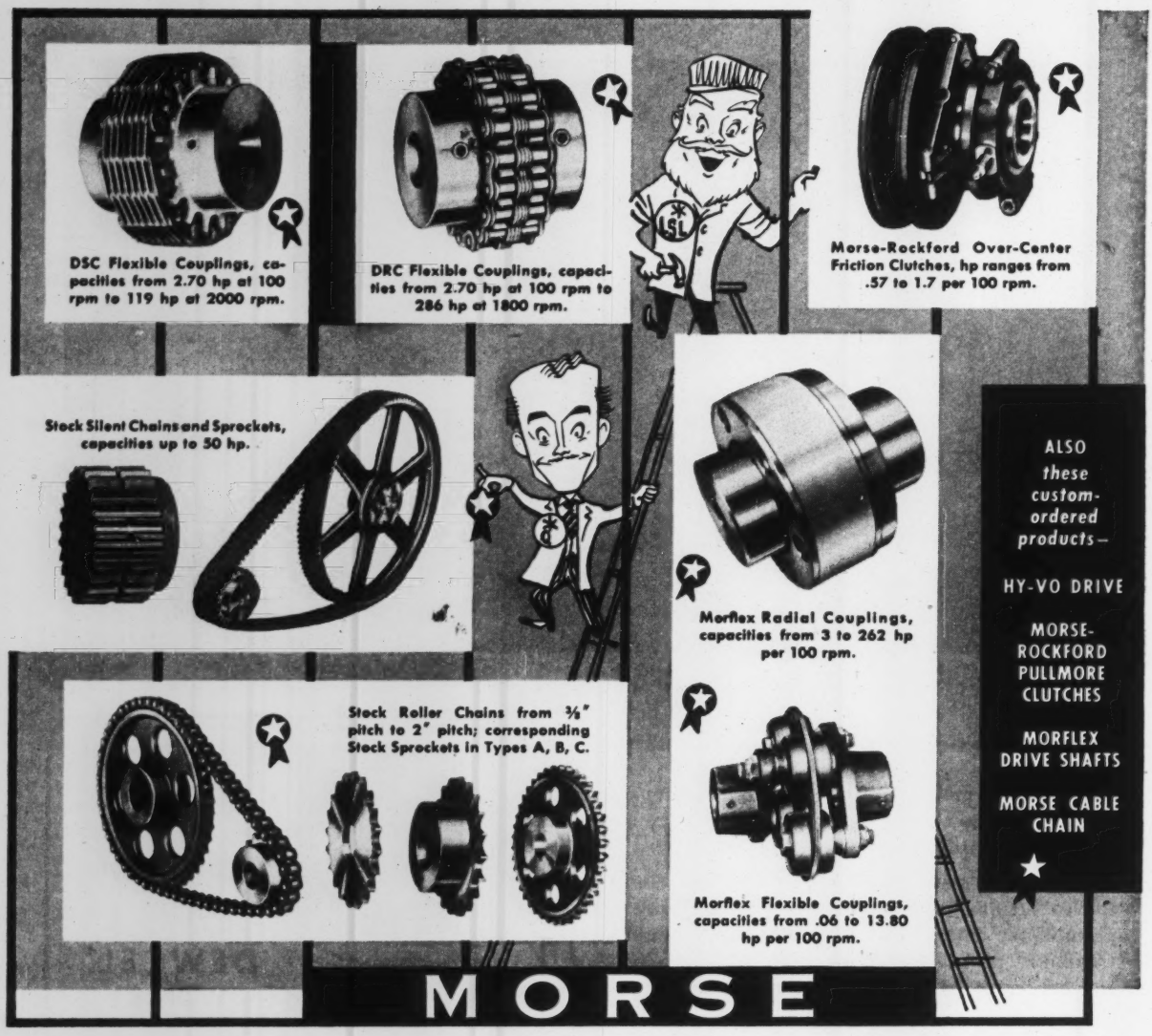
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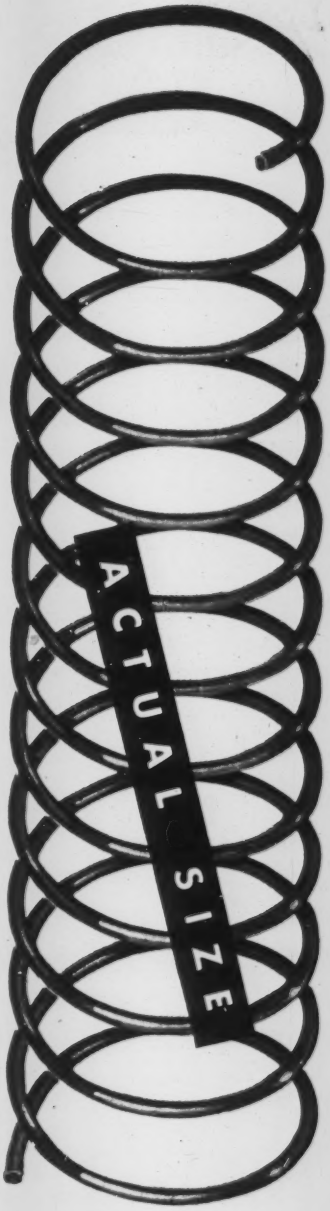

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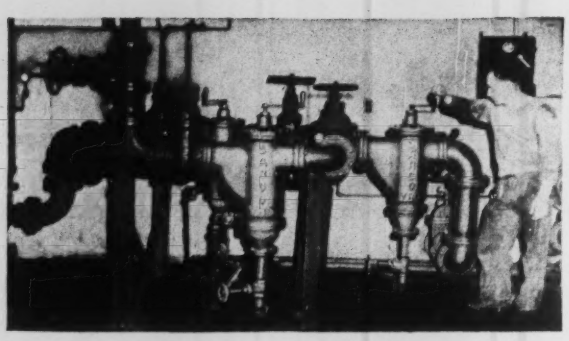

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Advt. 617

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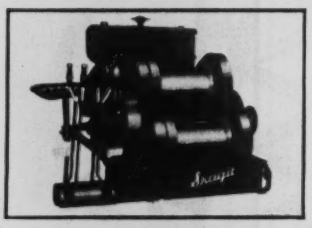

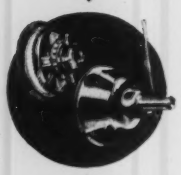

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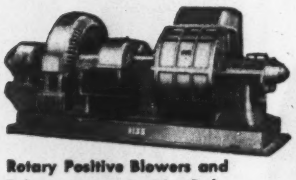
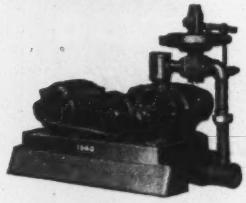
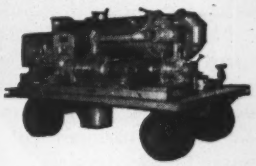


Rotary Positive Blowers and Exhausters—capacities 5 cfm to 50,000 cfm.



Rotary Positive Gas Pumps —capacities 5 cfm to 50,000 cfm.



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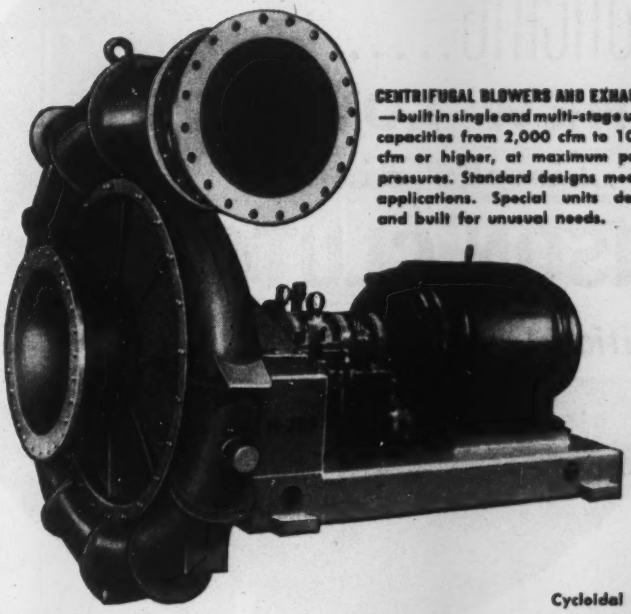

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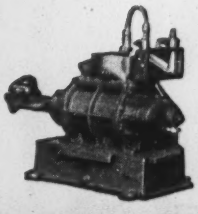

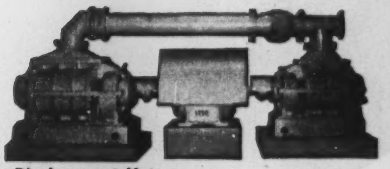

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Your business probably *is* different when it comes to handling gas or air. You may want to move a thimbleful of gas—or create a cyclone of whirling air. But, no matter how your problem differs from your neighbor's, the chances are that we've met something pretty close to it, in our almost a century of experience of building such equipment.

Another reason why we know so much about this job is that it's all we do. Our customers range from the "giants of industry" to the neighborhood plant, both of whose production depends upon continuous, reliable, economical performance of air and gas handling units. Because we build the exclusive *dual-ability line* of Rotary Positive and Centrifugal Units, in a wide range of sizes, we offer a *dual choice* not available from any other maker—which permits completely unbiased recommendations.

So—if you have a problem today—or anticipate one a year or five years from now, we suggest you call upon the R-C Specialists—to give you a long-time, satisfactory answer. Write for bulletins on any specific equipment.

ROOTS-CONNERSVILLE

Exclusive Specialists in Handling Gas and Air

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC. • 153 MICHIGAN AVE. • CONNERSVILLE, INDIANA

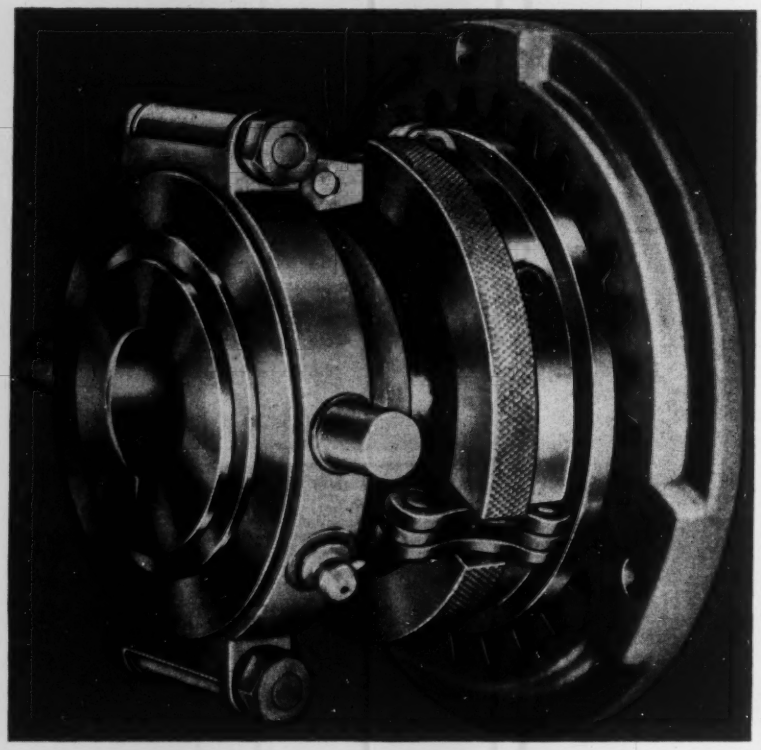
ANNOUNCING.....

THE NEW LOW COST

single disc

JOHNSON CLUTCHES

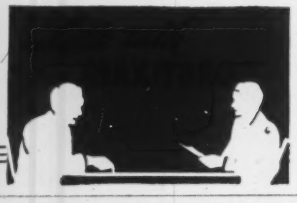
an addition to the* MAXITORQ *line



The Johnson 350 and 450 Single Disc Clutches are the newest additions to the Carlyle Johnson line... fitting companions to the Maxitorq multi-disc series.

They are ideal for light machinery service to 6 H.P. Several driving combinations are available, including V-belt. Far greater capacity at low cost is provided. (See column at right for typical applications.) They have the same "floating disc" principle as the Maxitorq Clutch . . . discs that ride free in neutral . . . no drag, no abrasion, no heating. A simple hex-key frees the knurled ring for easy manual clutch adjustment. Machine designers will find the solution to many problems with this new Johnson Clutch.

Send for Bulletin
#250—ME-1



Frankly

SPEAKING

Because of a large backlog of orders, The Carlyle Johnson Machine Company found it necessary to postpone the announcement of the new Johnson Single Disc Clutches.

Now, with added equipment for high speed production, it is possible to produce and ship the new clutches without undue delay. In fact, small orders or units for try-out in new machines will be forwarded at once. Design features make the Johnson especially suitable for installation in the following machinery:

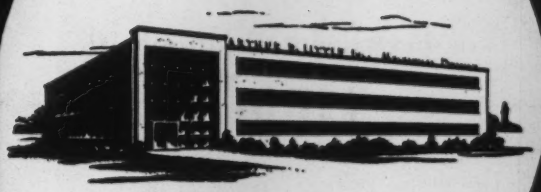
Accessory Drives, Air Compressors, Bag Making, Boat Drives, Bread Wrapping, Chain Drives, Combines (farm), Conveyors, Crop Seeders, Cultivators, Dusting Machines, Feed Grinders, Floor Scrubbing, Fruit Cleaners, Gasoline Engines, Generator Drives, Hay Balers, Hoists, Loaders, Lawn Mowers, Milk Coolers, Mixing Machines, Motor Scooters, Packaging Machines, Paper Shredders, Power Fans, Power Saws, Power Take-Offs, Pumping Equipment, Sand Spreaders, Sewing Machines, Sheep Shearers, Spraying Equipment, Textile Machinery, Threshers (small), Tobacco Machinery, Tool Grinders, Tractors (garden), "V" Belt Drives, Vegetable Sorters.

Naturally, these are but a few of the possible applications for the Johnson Single Disc Clutch. The field is wide open, with new machinery constantly being developed.

Included in the driving combinations are: Gear Tooth, Bolted Plate, Pulley Type, Hub Adapter, Cut-Off Coupling Adapter, Single V-Belt Pulley Drive, and Double V-Belt Pulley Drive.

Carlyle Johnson engineers offer their engineering assistance in cooperation with your engineers and machine designers to develop the correct solution of your power transmission requirements. Write to Frank R. Simon, The Carlyle Johnson Machine Co., Manchester, Conn.

UNIQUE PROTOTYPE DEVELOPMENT



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IF lack of personnel has halted development of your new ideas or new products, the ADL Mechanical Division can take over and bring them to complete maturity.

Arthur D. Little, Inc., has blended its scientific and engineering skills in the Mechanical Division to provide industry with a unique service . . . prototype development of equipment requiring a high level of engineering. Scientists in the fields of chemistry, physics, metallurgy, mathematics, biology, electronics and technical economics can be called on as required.

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- **400 cycle frequency**
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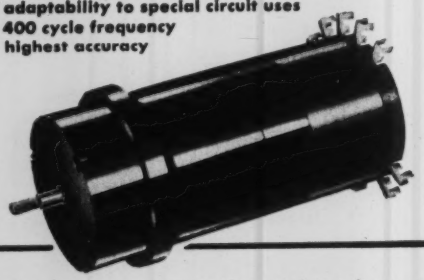

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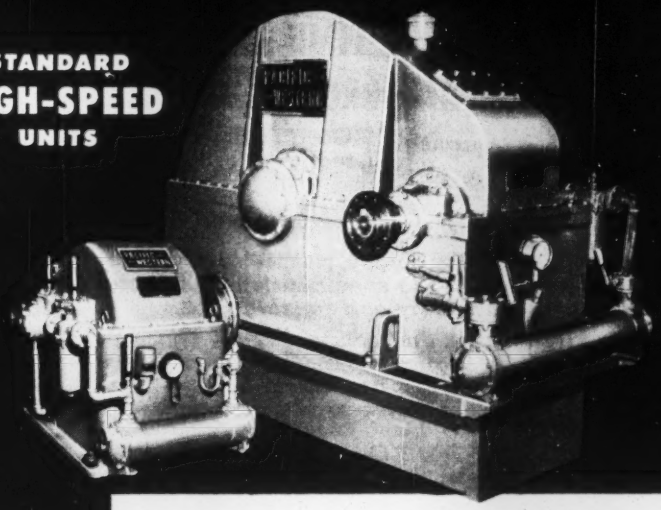

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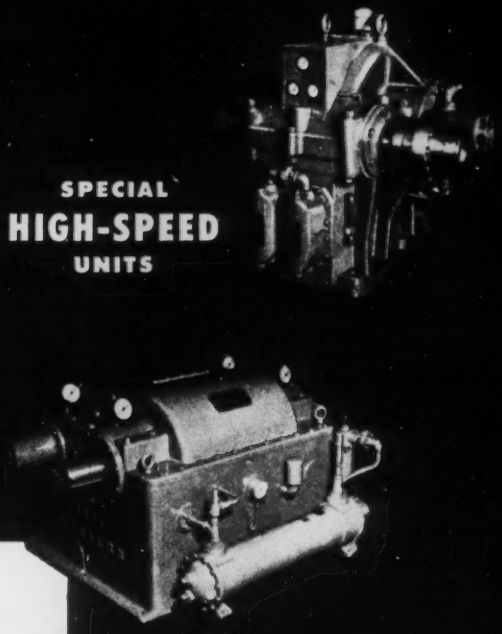
UNITS



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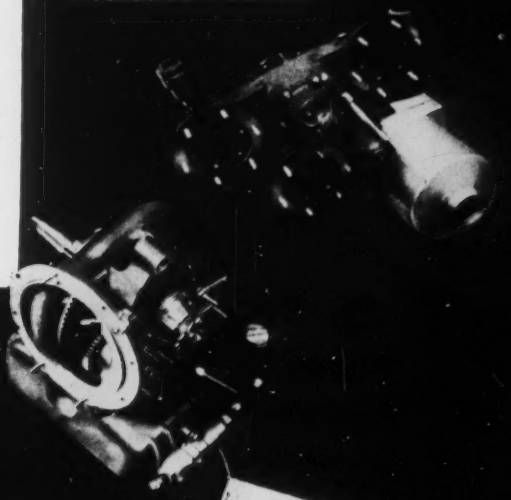

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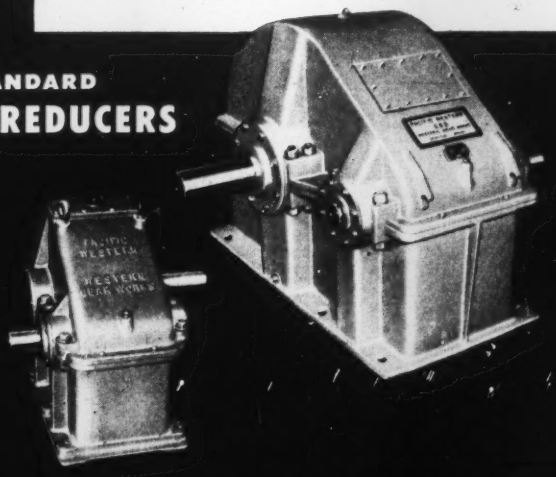

New Catalog Available—
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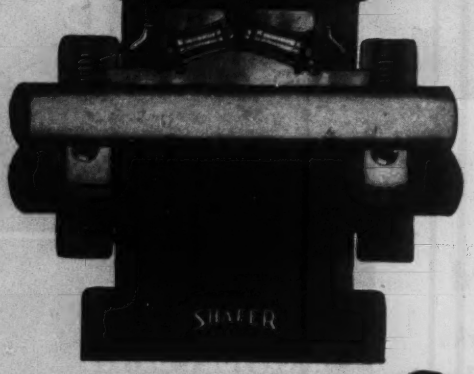
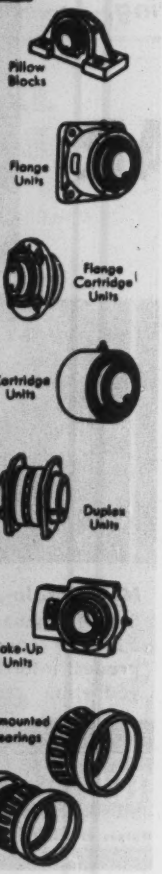
THE *Rugged* JOBS ARE "*Routine*" FOR SHAFER BEARINGS



Throughout the land Shafer Roller Bearings are increasing the nation's productive capacity—carrying big loads, saving money and power, reducing down time and maintenance costs wherever America's heaviest duty power transmission equipment is at work.

Shafer Bearings handle these tough jobs better because they are engineered to-the-job—to provide *longer* life, greater dependability and *lower* operating costs under the severest working conditions. Integrally self-aligned, they have full radial-thrust and greater reserve shock load capacities under all conditions of misalignment; are equipped with self-centering "Z" housing seals and Micro-Lock 12-point adjustment. See the Shafer bearing specialist near you . . . or write us direct . . . for complete information and engineering consul on a no-obligation basis. SHAFER BEARING CORPORATION, 801 Burlington Avenue, Downers Grove, Illinois.



SHAFER
SELF-ALIGNING
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You SAVE TIME & MONEY by using AMB BRONZE CASTINGS

. . . *because* (1) *Good sound castings* mean *minimum rejects,* and the saving of time and money *wasted in useless finishing and assembly work.*

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Proof of AMB Quality and Service may be readily obtained from our customers.

Note: Our new, flat opening, flexible-bound "Reference Book on Bronze Casting Alloys" has just come off the press — copy will be sent upon request on your Business Letterhead.

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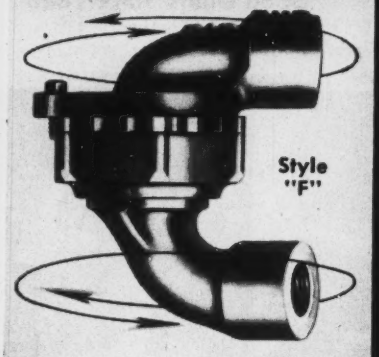
for pipe lines that *move!*



For unrestricted flow of steam, air, or fluids through moving pipe lines or to equipment in motion.

Complete 360° swing. The strength of pipe with the flexibility of hose. Only four parts assure long wear, low maintenance. No springs, small or loose parts. Four styles in standard pipe size, ¼" to 3".

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This man must be capable of supervising the design and layout of refinery plants including the selection of required equipment.

Furnish an outline of your education, experience and reference. Salary open.

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Graduate Engineer, minimum 10 years' experience in design of mechanical building services and distribution, boiler houses and steam distribution. Some experience in heavy machinery desirable but not essential.

LIBERAL SALARIES

commensurate with experience and ability. Vacations with pay and other benefits.

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of education and experience, salary requirement, references, and availability date with first letter.

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MECHANICAL ENGINEERS

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- **Layout & over-all system design**
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Suburban location adjacent to Washington, D. C., affords pleasant living conditions and is accessible to 4 universities offering graduate courses. Reasonable relocation expenses.

All replies confidential.

Please forward resumé to

Personnel Department
Silver Spring Laboratory

VITRO CORP. OF AMERICA
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Responsible permanent position in new section of established company.

Graduate, age 35-50, experienced in chemical industry design including pressure vessels, piping, materials and specifications.

Paid holidays . paid vacation . low cost group health, accident, and life insurance . retirement plan.

Salary commensurate with ability and experience.

Submit resumé of personal history . education . experience . salary expected.

Application confidential.

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CONSULTING ENGINEERS
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SERVO-MECHANISMS

Positions are available at West Lynn, Mass. and Cincinnati, Ohio. Please do not apply if your best skills are being used for vital defense work. Send your resume to: Technical and Supervisory Personnel, Aircraft Gas Turbine Division, Dept. M.

GENERAL ELECTRIC
P.O. BOX 196 CINCINNATI 15, OHIO

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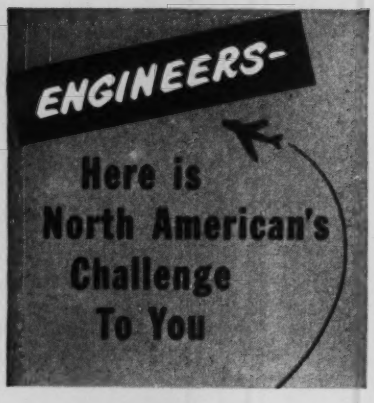
Eight Pages of "OPPORTUNITIES"



Frankly, working at North American requires hard thinking and plenty of vision. Because North American always works in the future. Yet, if you are interested in advanced thinking, if you'd like to work on the planes that will make tomorrow's aviation history, you'll like working at North American. North American offers these extra benefits, too.

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- **Stress Engineers**
- **Aircraft Designers and Draftsmen**
- **Specialists in all fields of aircraft engineering**
- **Recent engineering graduates**
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The following additions to our permanent staff are needed for research on smokeless powder, rocket propellants, detonators, dynamites, and other explosives chemicals.

4 Chemists
3 Chemical Engineers
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Experienced men particularly needed for responsible work: salaries commensurate. Staff positions also available for chemical or mechanical engineer in estimating cost of proposed research processes and in market studies; also research librarian.

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Employment Manager
OLIN INDUSTRIES, INC.
Explosives Division
East Alton, Illinois

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Research positions available with large machine tool company in an expanding research program. Engineers with expert experience in hydraulic control systems, servomechanisms and stress analysis needed. Individuals with aircraft design experience are particularly invited to explore the possibilities offered by these positions. Engineers with a sincere interest in making basic contributions to industrial productivity through a basic industry will find challenge and unusual opportunity here.

Address CA-4073, % "Mechanical Engineering."

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Established firm of consulting engineers has opening on its consulting staff for experienced technically qualified Fuel Specialist conversant with solid, liquid and gaseous fuels used in large steam electric generating plants; sources, characteristics, etc. Competent to make studies of comparative economics; determine market possibilities; determine trends as to costs. Also assist selection plant sites as sources and economic worth of fuels relate to selection. Utility background desirable. Give full particulars, education, experience and personal information.

Address CA-4160, % "Mechanical Engineering."

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There is also an opening for a good career draftsman who enjoys layout and design work.

Howell is located 50 miles west of Detroit, within a short drive of Lansing and Ann Arbor, in the lake region of lower Michigan, and offers many rural living advantages.

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R. P. Ballou, Chief Engineer
Howell Electric Motors Co.
Howell, Michigan

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With technical education and ten to fifteen years of experience in design and development of heavy machinery or similar experience, for research and development work both as to design and from industry study points of view. Permanent position with opportunities to grow are involved in expanded program of well-established heavy machinery, rolling mill and hydraulic press builders. Location Pittsburgh. Write complete details of experience pertinent personal information, and enclose photograph in first letter. Salary $7,000 to $9,000 per year, depending upon experience.

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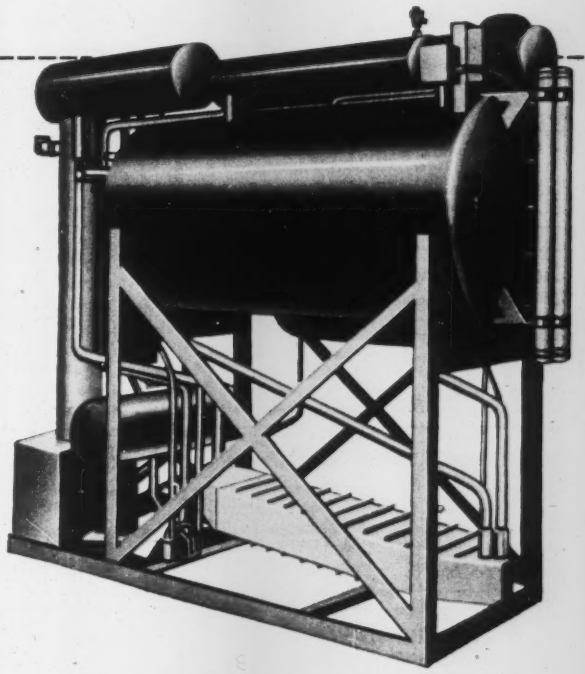

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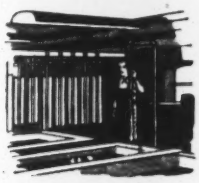

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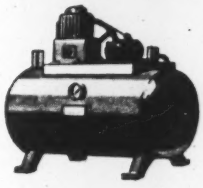

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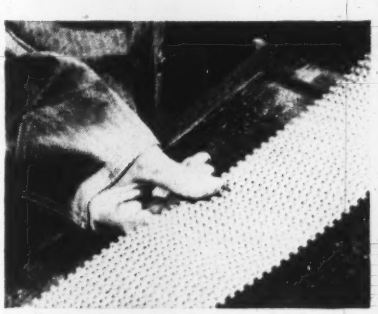
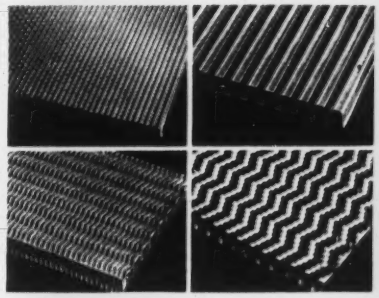
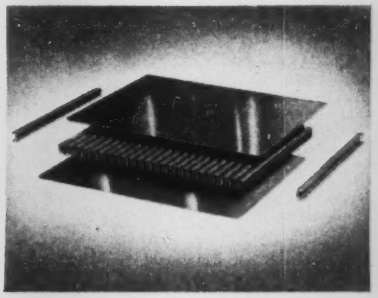
Here's how Trane brazes aluminum to solve tricky heat transfer problems...



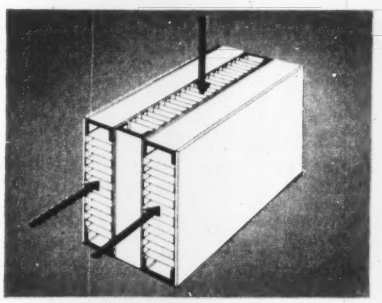
Corrugated fin surface for TRANE Brazed Aluminum Exchangers is formed in special presses from aluminum brazing sheet. Thickness can range from .005 to .032 inch; fin height to .50 inch; spacing 4 to 18 fins per inch.



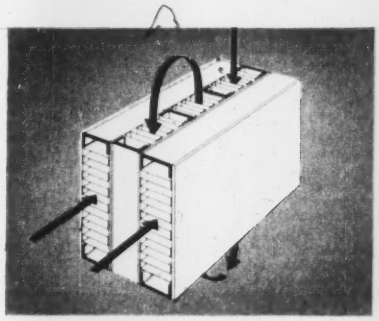
Many types of surface available. The brazed aluminum fins may be straight and continuous. Or they can be wavy, serrated or perforated to provide correct ratio of heat transfer to pressure drop.



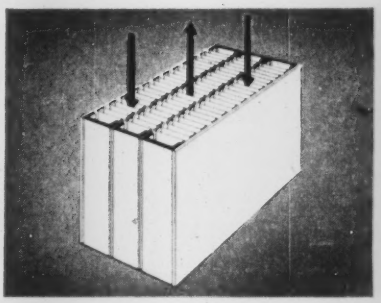
Exploded view shows component parts of a single passage. Fins, channels and parting sheets, all made from aluminum brazing sheet, become integrally bonded when assembled unit is submerged in a molten salt flux bath.



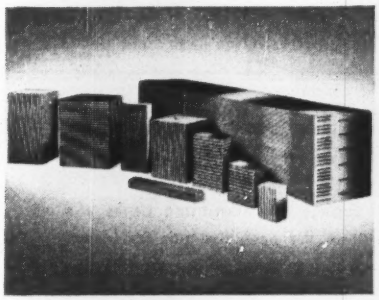
Cross-flow arrangement has fins in adjacent passages running crosswise to each other. TRANE Brazed Aluminum Surface can pack 450 square feet of heat transfer surface into one cubic foot of space.



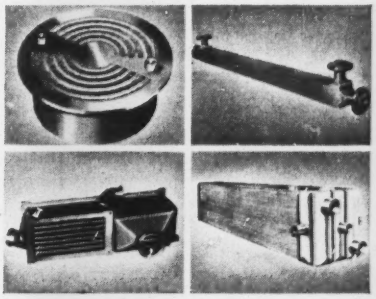
Multi-pass arrangement, like the cross-flow type, has fins in adjacent passages running crosswise to each other. With this arrangement, however, alternate passages are constructed to produce multiple passes.



Counter-flow arrangement has fins in adjacent passages running parallel to each other. A wide variety of different types of corrugated fin sheets can be used to handle different fluids in the same exchanger.



A wide range of core sizes is available up to 106 inches in length. Either bolt-on or integrally welded headers can be provided. Individual cores can be welded together to form larger multi-core units.



Design flexibility permits construction of units to handle practically any specification of heat transfer, pressure drop, volume, number and direction of passes. Some units handle as many as six different fluids simultaneously!

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If you have a tricky problem in heat transfer . . . TRANE Brazed Aluminum Exchangers may be the answer. Contact your TRANE Sales Office or write direct.

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MECHANICAL ENGINEERING, 29 W. 39th St., New York 18, N. Y.

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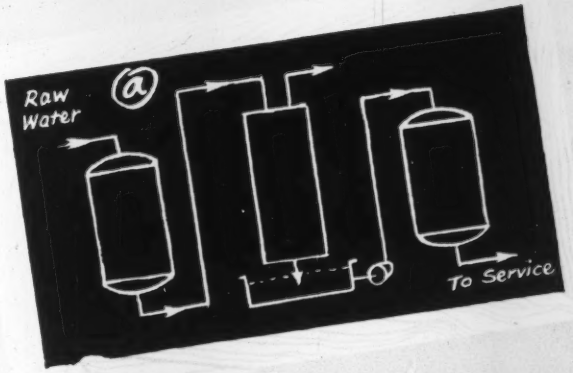
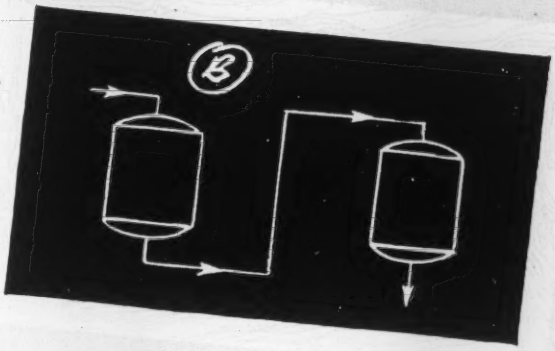
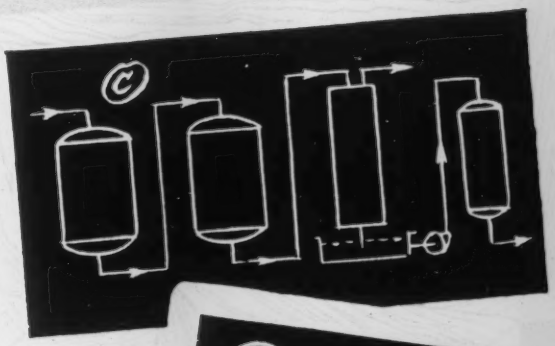
Reader Service Coupon For More Information

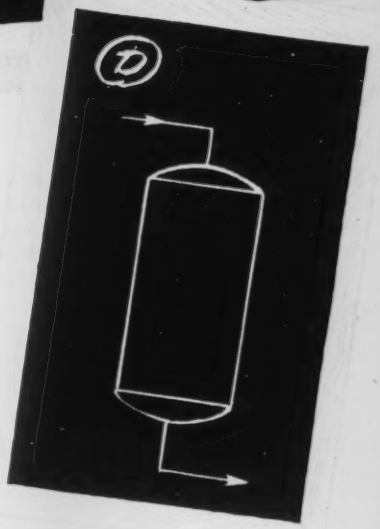
Go through the advertising pages and jot down the page numbers and names of advertisers about whose product you want additional information — mail the coupon to us — your request will be passed on to the advertiser promptly — you will hear directly from advertiser — saves your time in writing individual letters.

The ABC's of Better Boiler Feedwater









Permutit ion exchange processes remove dissolved mineral matter including silica. And produce feedwater equivalent to distilled water at only a small fraction of the cost of distillation.

For high pressure power plants that means it is now possible to avoid boiler scale and hard-to-remove silica deposits on turbine blades.

Demineralization is accomplished by the use of two ion exchange resins—Permutit Q and Permutit S. Permutit Q is a high capacity hydrogen cation exchange resin. Permutit S is a highly basic anion exchange resin.

Several arrangements of equipment are used depending on the individual requirements—composition of the raw water, volumes to be treated, boiler pressures and operating conditions. Permutit will cooperate with you in selecting the hookup best suited for your boiler plant. Write today for full information.

TWO STEP WITH DEGASIFIER: In large demineralizing plants, a degasifier is usually included as an inexpensive means for removing carbon dioxide.

TWO STEP WITHOUT DEGASIFIER: No repumping required. Used where total quantities are not very great or with waters of low bicarbonate content.

THREE STEP WITH DEGASIFIER: Extremely economical and effective arrangement for waters containing relatively high amounts of sulfates and chlorides.

MIXED BED: An extremely compact arrangement. Both cation and anion exchangers are in the same unit. Used alone or as a final step.

The equipment described is also furnished in multiunit arrangements to treat whatever quantities of water are required and to meet all operating conditions.

PERMUTIT

The sole manufacturer of all types of cation and anion exchangers and equipment.
THE PERMUTIT COMPANY, Dept. ME-1,
330 West 42nd Street, New York 36, N. Y.

Permutit Company of Canada, Ltd.,
6975 Jeanne Mance Street, Montreal.

PACKAGED V-BELT FAN UNITS

BETTER FOR MANY AIR HANDLING APPLICATIONS

NEW! CLARAGE DEVELOPMENT

Clarage Ready Units are a notable advance in "packaged" fan units — highly efficient, compact, quiet in operation. And, like all other Clarage equipment, you can RELY on them for dependable, economical service.

MOTOR DRIVEN ASSEMBLIES—NO EXPENSIVE FOUNDATIONS REQUIRED

Clarage V-belt Ready Units come in 18 sizes — capacities to 12,000 c.f.m. . . . within their range, the ECONOMY ANSWER to almost any INDOOR or OUTDOOR air handling requirement.

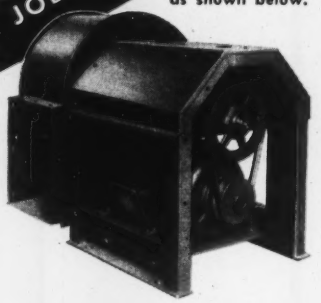
Use Ready Units and save the expense of building separate motor foundations. Use Ready Units and eliminate alignment problems. Use Ready Units for installations in record time and at lowest cost consistent with quality fan equipment.

Ready Units with or without Outdoor Covers shipped immediately. Specially constructed units for handling corrosive gases, etc., take a little longer.

WRITE FOR READY UNIT CATALOG 515 giving details, capacities and dimensions on the most modern "packaged" fan units available today — address, CLARAGE FAN COMPANY, Kalamazoo, Michigan.

INDOOR JOBS

Standard Ready Units (except three largest sizes) afford protection to fan bearings, motor and drive as shown below.

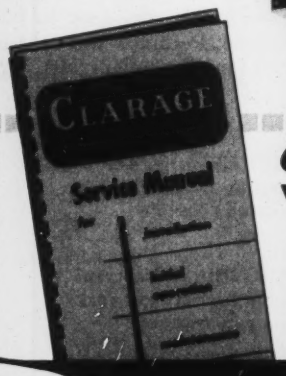


OUTDOOR JOBS

Cut below shows Ready Unit equipped with (easily removable) Outdoor Covers shielding all working parts from rain and snow.

LARGER SIZES

Cut at left shows standard Ready Unit as built in three largest sizes. These larger units, too, can be equipped with Outdoor Covers.



68 PAGES OF VALUABLE INFORMATION

New Manual shows how to properly install and service Clarage fans, blowers and air conditioning units . . . valuable information adaptable to almost any type of fan job. Sent without charge to factory executives, engineers and maintenance officials.

You can Rely on . . .

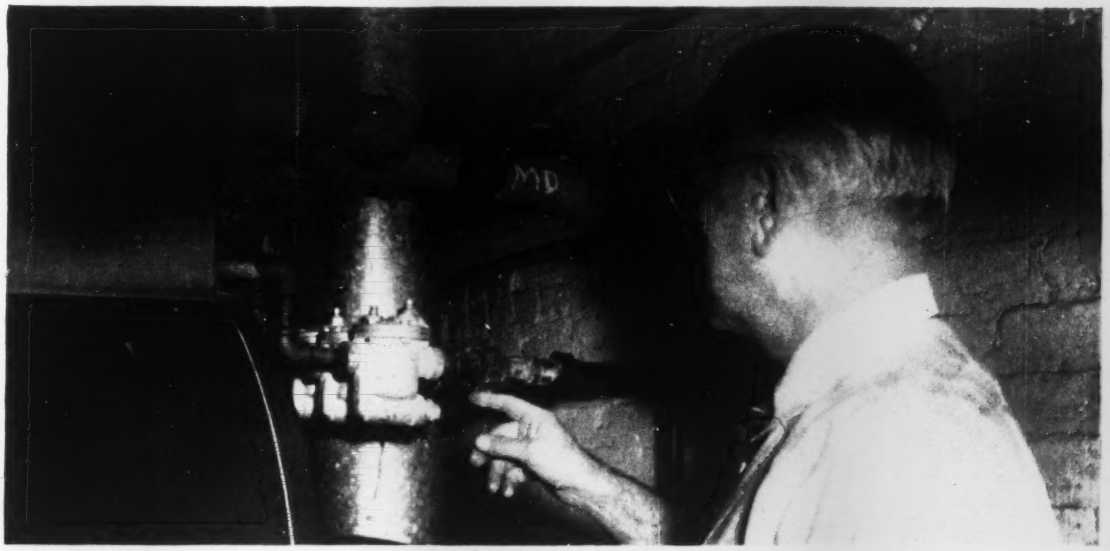
CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

User Explains How Armstrong Unit Trapping Boosted Output:

Need for Investment in New Steam Equipment Eliminated by Only $550.00 in Steam Traps



THIS is a story about greatly increased efficiency in a laundry, but the principles involved apply to any plant using steam heated equipment.

In speaking of the benefits derived from Armstrong Unit Trapping, Earl Fast of Soft Water Laundry and Cleaners, Long Beach, California, said, *"It's like a man with dirty eyeglasses—he thinks he's seeing perfectly until he cleans the glasses and finds out what he has missed."*

Mr. Fast's plant modernized its entire return system in 24 hours, installing 71 Armstrong traps costing about $550, with these results:

1. Capacity of machines costing as much as $15,000 per unit increased to the extent that new machines are not now required.
2. Higher quality of ironing and finishing, with touch-up on shirts eliminated.
3. Worthwhile fuel savings.

"Our boiler was turning out plenty of steam," continued Mr. Fast, "but we weren't getting the benefit of it. The best power plant in the world is of no value if you don't use its produced steam to maximum efficiency."

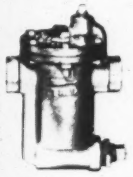
And there lies the case for Armstrong Unit Trapping, which discharges air and condensate as fast as it accumulates to keep steam heated equipment hot and producing at a peak rate. Your local Armstrong Representative will be glad to survey your condensate drainage system without obligation. Call him or write:

ARMSTRONG MACHINE WORKS

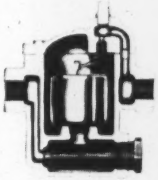
894 Maple Street • Three Rivers, Michigan

Traps with Built-in Strainers Cut Costs

Because the piping at Soft Water Laundry was old, the smallest-sized traps needed protection against dirt and scale. Armstrong No. 880 and 881 traps with built-in strainers were the logical answer because:



1. They cost less than a separate trap plus a strainer.
2. They eliminate external fittings and considerable installation labor.



Left—Cut-away view showing strainer screen at trap inlet. Strainer can be cleaned without removing or shutting off steam.

You always get more out of equipment when you use Armstrong "Unit Trapping"

FREE
44-PAGE STEAM TRAP BOOK
Gives Complete Information
MAIL TODAY!

FILL IN AND CLIP TO YOUR COMPANY LETTERHEAD

ARMSTRONG MACHINE WORKS
894 Maple Street, Three Rivers, Michigan

Please send me a Steam Trap Book.

Name .....

Title .....

4-A lathe gets A-1 precision with TIMKEN® bearings

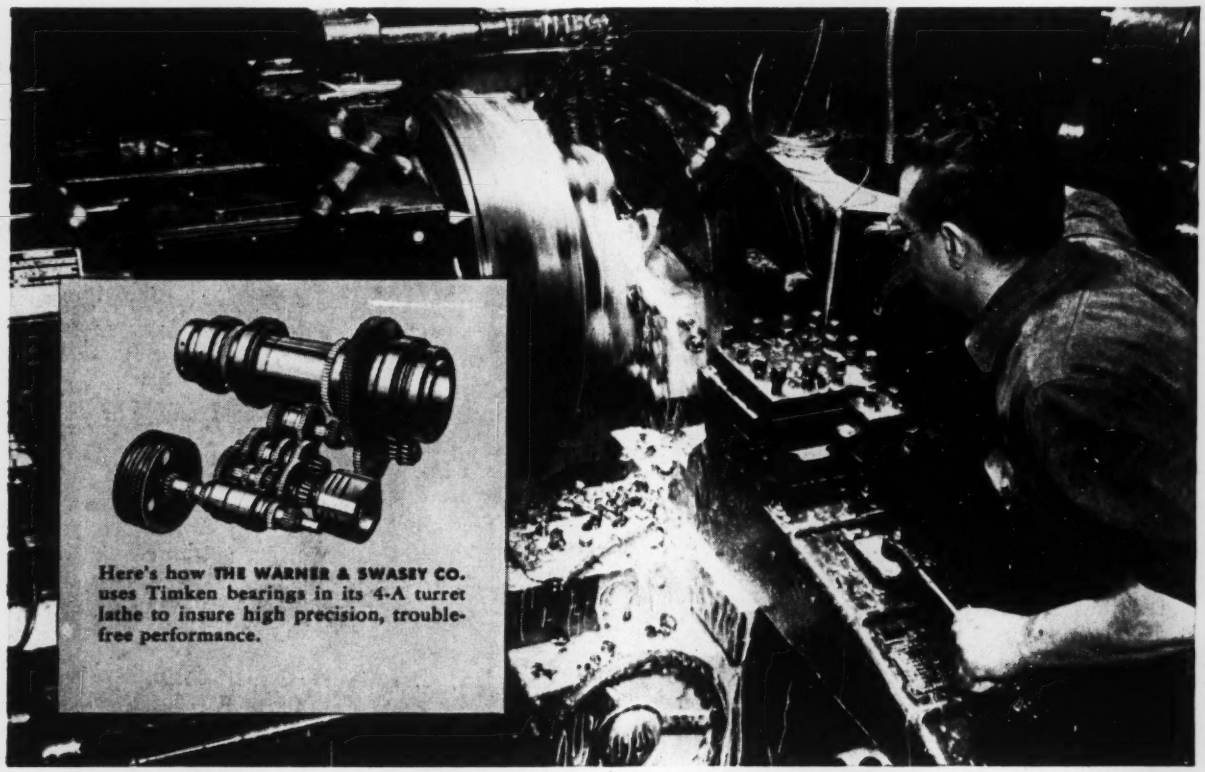
THIS Warner & Swasey 4-A turret lathe hogs off tough metal in a hurry, yet provides the high precision demanded for today's close-tolerance parts. Warner & Swasey engineers assure both precision and ruggedness by mounting the spindle and 12-speed gear train on Timken® tapered roller bearings.

Whether you're using a one-inch drill or making a 28" turning cut, Timken bearings maintain spindle precision and accurate gear mesh day in and day out. They are tapered in construction to take radial, thrust and combination loads. Line contact between rollers and races provides maximum capacity. Shafts are held in rigid alignment. Gear mesh is smoother, more accurate. Shaft wear is eliminated, gear wear reduced.

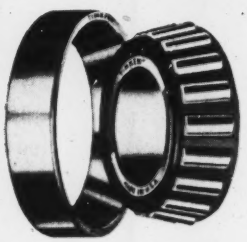
True rolling motion and an incredibly smooth surface finish combine to make Timken bearings practically friction-free. They're made from Timken fine alloy steel—finest steel ever developed for tapered roller bearings—and rollers and races are case-hardened for hard, wear-resistant surfaces and tough, shock-resistant cores.

No other bearing can offer you all the advantages of Timken bearings. Be sure to use them on the machine tools you build or buy. And look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



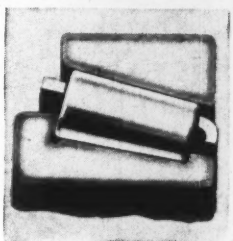
Here's how THE WARNER & SWASEY CO. uses Timken bearings in its 4-A turret lathe to insure high precision, trouble-free performance.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



GREATER LOAD AREA

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ↓ AND THRUST →○← LOADS OR ANY COMBINATION →○←